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Vol. 22. 218 WILLIAM STREET, NEW YORK. No. 2.

Contents and Index to Advertisers, Page 11.

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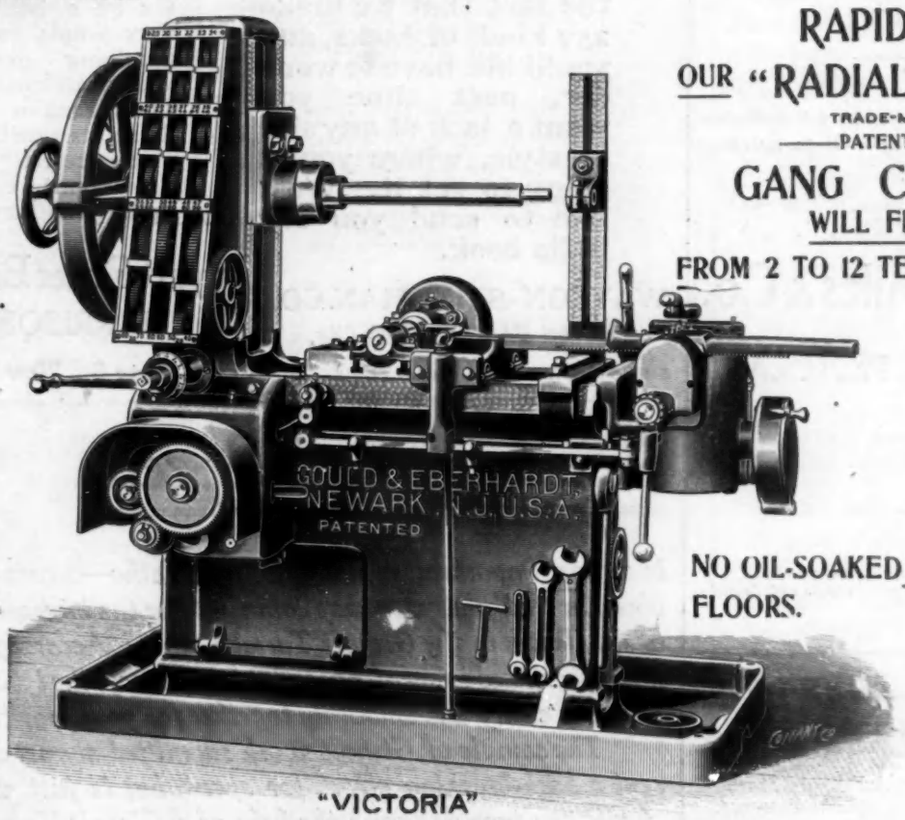

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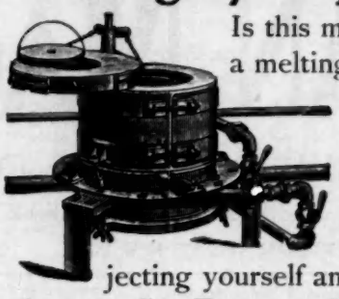

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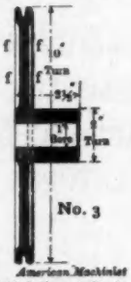

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Index to Advertisers.

	PAGE
Acme Machinery Co	16
Adams Co., The	13
Albro-Clem Elevator Co	7
Almond, T. R.	10
American Gas Furnace Co	2
American Tool & Machine Co	4
American Tool Works Co	47
American Turret Lathe Works Co	7
Armstrong Bros. Tool Co	13
Armstrong Mfg. Co	4
Backus Water Motor Co	41
Baird & Co., Henry Carey	41
Baird Machinery Co., U	39
Baker Brothers	44
Baldwin, Davidson & Wight	12
Ball Bearing Co	16
Barnes & Co., W. F. & John	9
Bartlett, Edwin E	9
Bay State Iron Works	46
Beaman & Smith	10 and 15
Becker Mfg. Co., John	15
Bement, Miles & Co	2
Berlin Iron Bridge Co	39
Besly & Co., Chas. H	48
Bethlehem Foundry & Machine Co	35 and 46
Bethlehem Iron Co	12
Bilgram, Hugo	12
Bliss Co., E. W	39
Blood, L. H	41
Boston Gear Works	41
Bradford Belting Co	12
Bradford Mill Co., The	40
Bristol Co	48
Brown & Co., R. H	3
Brown & Sharpe Mfg. Co	48
Buckeye Engine Co	8
Buffalo Forge Co	48
Builders' Iron Foundry	38
Bullard Machine Tool Co	44
Burt Mfg. Co	35
Carborundum Co., The	8
Card Mfg. Co., S. W	39
Case Mfg. Co	38
C & C Electric Co	9
Chandler & Taylor	46
Chisholm & Moore Mfg. Co	39
Cincinnati Milling Machine Co	40
Cincinnati Shaper Co	13
Cleveland Gear Works	35
Cleveland Machine Screw Co	4
Cleveland Twist Drill Co	48
Clough, R. M	38
Coes Wrench Co	13
Coffin & Leighton	9
Cook Co., Asa S	3
Crescent Steel Co	8
Crosby Steam Gage & Valve Co	46
Curtis & Co., Mfg. Co	8
Curtis & Curtis	4
Cushman Chuck Co	3
Dallett & Co., Thomas H	42
Davis Machine Co., W. P	16
Dayton Globe Iron Works Co	46
Detrick & Harvey Machine Co	42
Diamond Machine Co	45
Dietz, Schumacher & Boye	5
Dixon Crucible Co., Joseph	13
Doan & Co., J. B	7
Draper Machine Tool Co	5
Dreses, Mueller & Co	37
Dwight Slate Machine Co	41
Eames Co., G. T	13
Errington, F. A	3
Evans Friction Cone Co	10
"Exports"	6
Faneuil Watch Tool Co	48
Fellows Gear Shaper Co	10
Fifield Tool Co	48
Fitts Mfg. & Supply Co., Frank E	38
Flather & Co	16
Foos Gas Engine Co	46
Forbes & Co., W. D	46
Fox Machine Co	16
Frasse Co., The	35
Frick Co	46
"F. R., 074"	6
Gang & Co., William E	9
Garvin Machine Co., The	42
General Electric Co., The	37
Geometric Drill Co	3
Gisholt Machine Co	2
Gleason Tool Co	16
Goodyear, S. W	4
Gould & Eberhardt	1 and 16
Grant Gear Works	16
Grant Machine Tool Works	8
Gray Co., G. A	16
Haeseler Co., C. H	44
Hamilton Machine Tool Co	12
Hampden Corundum Wheel Co	3
Hartford Steam Boiler Insp. & Ins. Co	38
Hart Mfg. Co	38
Henderer's Sons, A. L	44
Hendey Machine Co	36
Hill, Clarke & Co	6
Hobson, Seaman & Co	9
Hoggson & Pettis Mfg. Co	3
Horseless Age	38
Horton & Son Co., E	3
Howard Iron Works	39
Hunt Co., C. W	41
Hurlbut-Rogers Machine Co	3
Hyatt Roller Bearing Co	2
Ingersoll-Sergeant Drill Co	41
International Correspondence Schools	42
Jenkins Brothers	37
Jessop & Sons, Wm	12
Jones & Lamson Machine Co	16
Kempsmith Machine Tool Co	4
Keuffel & Esser Co	42
Keystone Electric Co	44
Landis Tool Co	4
Le Blond Machine Tool Co., R. K	48
Le Count, Wm. G	3
Lodge & Shipley Machine Tool Co	6 and 44
Long & Allstatter Co	12
Lucas & Gliem	16
Mackey Co., The	7
Main Belting Co	13
Maris Brothers	10
Marshall & Huschart Machinery Co	6
McCabe, J. J	6 and 43
Merrell Mfg. Co	4
Mietz & Weiss	46
Montgomery & Co	3
Moore Cycle Fittings Co	6
Morrison & Co., Thos	35
Morse Twist Drill & Machine Co	15
Morse, Williams & Co	7
Morton Mfg. Co	13
Mossberg & Granville Mfg. Co	7
Newark Machine Tool Works	6
New Doty Mfg. Co	46
New Era Iron Works	46
New Haven Mfg. Co	7
New Process Raw Hide Co	13
New Process Twist Drill Co	9
Newton Machine Tool Works, Inc	12
Nicholson File Co	38
Niles Tool Works Co	6
Norton Emery Wheel Co	41
Oesterlein Machine Co., The	16
Oster Mfg. Co	8
Palmer Brothers	46
Pearson Machine Co	48
Pierce Engine Co	46
Pond Machine Tool Co	43
Pope Mfg. Co	7
Powell Planer Co	9
Pratt & Whitney Co	39
Pratt Chuck Co	14
Pratt Institute	12
Prentiss Tool & Supply Co	6
Q & C Co	12
Quint, A. D	38
Rand Drill Co	46
Reed Co., F. E	41
Reeves Pulley Co	10
Rogers & Hubbard Co	39
Rogers Boat, Gage & Drill Works, John	47
Rue Mfg. Co	46
Safety Emery Wheel Co	4
Saunders' Sons, D	42
Sebastian Lathe Co	37
Sellers & Co., Inc., William	16
Seneca Falls Mfg. Co	8
Shultz Belting Co	16
Sibley & Ware	2
Sittman & Pitt	8
Skinner Chuck Co	3
Slocomb & Co., J. T	39
Smith & Mills	13
Snyder, J. E	9
Spencer Automatic Machine Screw Co	45
Springfield Gas Engine Company	46
Springfield Machine Tool Co	40
Standard Tool Co	48
Starrett Co., L. S	10
Steel Ball Co	41
Stevens Arms & Tool Co., J	42
Stiles Press Co., E. S	41
Stover Novelty Works	4
Stuart's Foundry & Machine Works, R. J	48
Tabor Mfg. Co	46
Tight Joint Co	46
Toledo Machine & Tool Co	3
Toomey, Frank	6
Towsley Mfg. Co., J. T	42
Trump Brothers' Machine Co	3
Turner, Vaughn & Taylor Co	37
T. & B. Tool Co	16
United Correspondence Schools	38
Walker, O. S	48
Walter, Edward P	7
Waltham Watch Tool Co	8
Warner & Swazey	48
Watkins Co., F. M	46
Watson-Stillman Co., The	2
Weber Gas & Gasoline Engine Co	46
Webster Mfg. Co	46
Westinghouse Electric & Mfg. Co	14
Whitcomb Mfg. Co	9
Whitney, Baxter D	3
Whiton Machine Co., D. E	3
Wiley & Sons, John	37
Wiley & Russell Mfg. Co	44
Williams & Co., J. H	42
Winkley, F. D	12
Woodward & Rogers	3
Woolley Foundry & Machine Works	13
Worcester Machine Screw Co	4
Wyke & Co., J	9
Wyman & Gordon	48
York Co., S. M	7
Young Mfg. Co., W. C	7

Contents.

	PAGE
System in Engineering Calculations and Records. By Chas. L. Griffin	17
The Mechanical Devices of an Ancient Illuminator. By R. I. Clegg	19
Bicycle Cup and Cone Grinding Machines	20
The Judges' Report on Motocycles at the Boston Show. By Hugh Dolnar	23
Diagram for the Design of Shafts. By G. Eugene Barrett	24
The Status of the Engineer. By J. S. Walker	24
A New Turret Lathe	28
Arms of Uniform Caliber	28
Down On It	28
Letters From Practical Men: The Human Element in Production. By Tecumseh Swift....Modern Boiler Practice. By W. H. Booth....Spherical Turning on the Lathe Centers. By C. Z. D....Rapid Tapping. By H. L. Cameron....Boiler Feeding—Taboo the "Wrist-Pin." By J. H. Dunbar....A Couple of Repair Jobs. By L. C. Sharp....Charges by Foreign Express Companies. By Durbrow & Hearne Mfg. Co	29-31
Nepotism in Machine Shops	32
What Can a Little Shop Do?	32
Rejuvenated "Locomotive Engineering"	33
Inquiry for Machinery	33
Must Press the Right Button	33
Personal	33
Obituary	33
Questions and Answers	34
Pittsburgh the Steel City	34
Commercial Review	36

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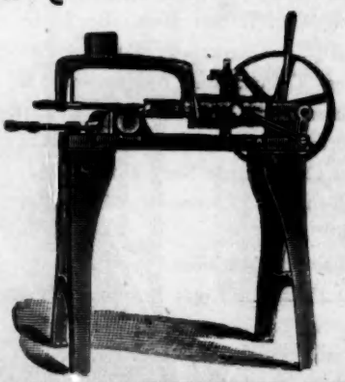

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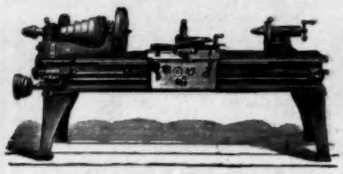

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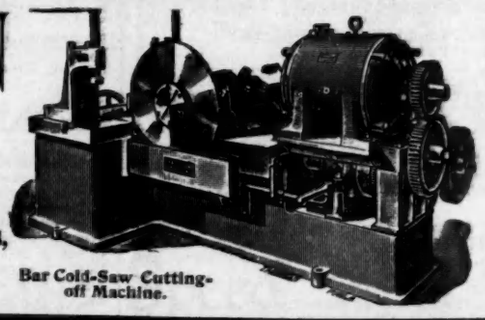
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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 22 NEW YORK, THURSDAY, JANUARY 12, 1899 NUMBER 2

System in Engineering Calculations and Records.

BY CHAS. L. GRIFFIN.

The article by Mr. Dixon in the current issue of the "American Machinist" on "The Moment of Inertia of Built-Up Beams" is a very practical one. From a workable, everyday, drawing room standpoint, this article is, to my mind, the best discussion of the detail calculation of plate girder cross sections that has hitherto fallen under my notice. Mr. Dixon has evidently "been there" himself, and realizes from practical experience just what the commercial side of the question calls for.

The calculation of plate girder cross sections involves a considerable amount of routine mathematical work, and even with all the calculating devices at hand, the process consumes some little time, which is not cheap time either. In addition to this there is the time of the designer in considering the design best adapted for the purpose, consistent with the limitations of economy, all of which means careful study by an expensive man. Thus the final cross section of the girder, which, as a drawing merely, could be made in a few minutes once it is designed, represents a considerable cost item. The number of girders designed in a year by a firm making a specialty of the business multiplies this cost by a large figure, especially if each case has to be calculated from the beginning. Hence it is not difficult to appreciate the value of some system of making, recording, and filing these expensive calculations so as to make the work, to some extent, accumulative and fundamental for future comparison.

The process of designing one girder alone by itself, without others to gage by in making assumptions, is a multiple process; that is, the best and most economical section is not usually found at the first trial, and this means several calculations repeated from the beginning. With a file of previous cases at hand with their computations, it is not difficult to make an assumption which will be pretty close at the first trial, and at least reduce the number of subsequent trials.

Again, a girder always fulfills a very responsible position in any structure, and it is of value to be able to quickly judge of the general accuracy of the work, for safety's sake, by comparison with cases on either side of it. For checking purposes alone the arrangement of calculations in systematic form is of sufficient value to warrant it. The checking of figures is, unfortunately, a necessary evil, owing to the fallibility of the human mind, but since we have it to meet, it is like any other commercial problem, one of dollars and cents, and a very little time saved day by day on work in the drawing room soon mounts up into good large dollars. The books of the firm will show it, and the eye of an experienced man will see it when he compares the number of men in the drawing room of an establishment with the number of men in the shop.

The application of the foregoing is seen in the accompanying sheet, reproduced from the original, which represents a typical girder calculation sheet. It is offered with an apology to Mr. Dixon, for the method and figures are as given by him in the aforementioned article. They are, however, precisely the figures and method which would have been used by the writer, and, being available, are pirated for arrangement on the calculation sheet in such systematic form that indexing and filing are easy. Doubtless Mr. Dixon has used some such scheme himself. Several hundred of such sheets have passed under my notice, when, as chief draftsman, my position was such that it was important at any time of day or night a girder section should be accurately worked out in the shortest possible time, and at the lowest cost.

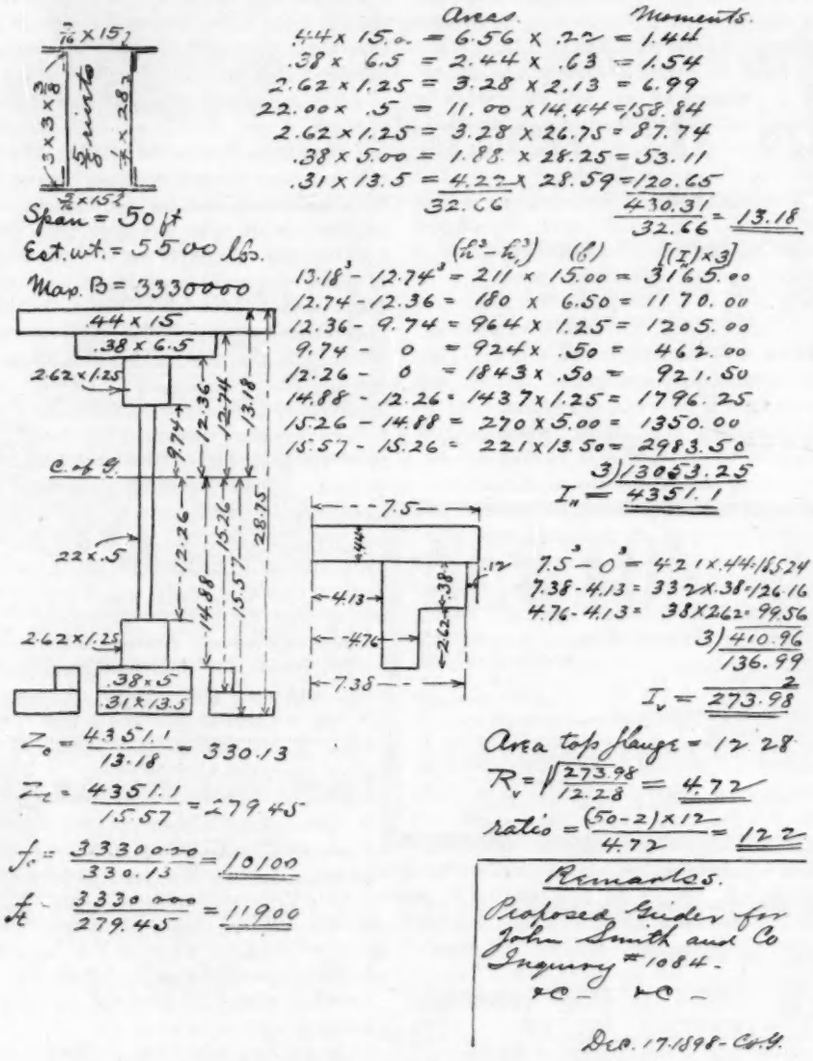
The sheet as used measured 8½ by 11 inches, but it could be any size convenient for filing. Beginning in the upper left-hand corner we have the section as planned, below it being the span, estimated weight, and maximum bending moment. It might be well to add to this the load with its distribution which produced the moment. A rough, enlarged section is now made below, being reduced to its simplest form, as suggested by Mr. Dixon. The routine calculation appears at the right of the figures and the resulting fibre stress in compression and tension will always be found in the lower left-hand corner. The ratio of unsupported length (in this case supposed to be 2 feet less than the span) to radius of gyration will always be found in the lower right-hand corner. The space for remarks will always be in its place, and its arrangement according to the indexing scheme.

In our case we had a separate card index, the cards being classified, if my recollection is correct, both by radius of gyration and moment of inertia. The convenience of the system proved itself by long usage, and the economy of it was evident to everybody who came in contact with it, from the business manager down to the man who made the figures.

The above seems a very simple and reasonable thing to do, and the scheme or its equivalent is doubtless in use by girder builders. The main object in discussing it at such length is to urge it as an excellent example of the value of not only employing careful system in the making of calculations, but of systematically recording them after they are made. Engineering calculations of any sort are expensive, and the case has never yet arisen where, at some subsequent time, labor, time, and expense would not have been saved had systematic record of past mathematical work been available. The idea of preserving calculations is not a new one, and it is already followed in sort of a lethargic fashion in many places. The insistence upon a regular habit, however, of making perfectly legible calculations, capable of interpretation by anybody at short notice, and readily accessible in a well-bound book, sufficiently indexed, is by no means as universal as it might be. There is no reason why the principal members of a machine should not have a definite, recorded reason for their existing proportions, and it is not a waste of time or needless red tape to accomplish this. It is as easy to make calculations legible as illegible, once the habit is fixed. It is not needless red tape to always have at hand the fundamental theory of well-proportioned and intelligently designed machinery. It reduces present similar calculation to a minimum of cost, and it places control of theory of design in the hands of the firm, where it belongs, thus affording relief from embarrassing loss of time when change of personnel in the engineering staff occurs.

This habit of systematic work may well be begun in the technical school or college, and it is my belief that sufficient stress is not laid on this highly important matter in the present courses. Much of the complaint which is rightly urged against the engineering graduate is in consequence of this hap-hazard, unmethodical style of action, with a total disregard for the importance of small details. His engineering notes are of little use to him in practical work, because of their lack of definiteness and detail, and because of their non-permanent form. In a couple of years or less they are undecipherable to him and everybody else.

There is no reason why an engineer's hand book should not be begun in college. Even if nothing else is accomplished, the habit is acquired of systematically recording experience, which is a long start on the road to successful practice. How frequent the remark among engineers "I wish I had started my note book sooner." How quickly some special computation is lost to the memory. How much time is wasted at some future time in reviewing the same train of thought to produce a result, which five minutes time in reference to well recorded notes is judged by the figures necessary to make the piece. Less than this is incompleteness. This is by no means a dead issue, and is a prolific source of vexation in most drawing rooms. The waste of time by chief draftsmen and others in charge of work in seeing that drawings are complete in this respect is considerable. One of the strangest things about it is that no draftsman seems to realize the importance of the method of putting all the dimensions on until he gets to be chief draftsman or in charge of work. It is a most difficult thing to bring a student to the nook and corner of a drawing, however complicated, is covered step by step. No man can put all the figures necessary on a drawing by simply looking at it and putting on one here and one there. He must start with some one piece and some one point of that piece, and travel round it until he comes back to the starting point. If the outside of a piece is being followed stick to it until it is finished. Then take the cores and do likewise. Then go all over the piece again and be sure nothing has been skipped. When this has convinced you that the figures are complete, then, and not till then, go to the next piece, and so on. Thus is left behind you piece after piece, completed, with no necessity of distracting your mind by reference to it again. This is not only the way to be sure that every dimension is on, but it is the quickest way, and, moreover, by the very method of the work, the dimensions will naturally group themselves together where they should be grouped, and separate themselves where they should be separated. Admittedly, an expert will place his figures more advantageously than a new hand, but to start right is to correct the hap-hazard habit, which can never produce positive work.



SAMPLE CALCULATION FOR I-BEAM. REDUCED FACSIMILE OF AN 8½ X 11″ SHEET.

An illustration is appended which is so simple that it is almost foolish to expect anything but complete figuring. Yet, in as simple a case as this, one frequently finds lack of dimensions, and the simplicity makes it the more exasperating.

Referring to the figure, which is nothing but a pipe elbow with a boss on it, start at some point as the left-hand flange, and locate it by the dimension 24 inches. Now stick to this flange until its figures are complete, 11 inches diameter, 1 inch thick, 9⅝ inches diameter of bolt circle, ⅞-inch bolt holes, 6-inch pipe. Then pass around the outside of the flange, ⅛-inch fillet, ½ inch thickness of pipe, 7 inches outside diameter, pitch radius of pipe 8 inches, locate face of boss 6 inches, diameter 4 inches, ½-inch pipe tap, fillet ½ inch, fillet ⅛ inch, locate face 12 inches, thickness of flange 1⅛ inches, diameter of flange 11½ inches, diameter of bolt circle 9¾ inches, ⅞-inch bolt holes, pipe same as before. This is all ridiculously simple, but it represents exactly what must be done on a more complicated drawing, and it is from lack of the systematic action pursued here that the fault of half-dimensioned drawings exists.

Engineering failures are almost invariably traceable to inattention to small and obscure details. Engineering success cannot be attained at a bound, and it is only by the cultivation of simple methodical habits of thought and lines of action until they become second nature, and occur spontaneously, that full positive control of daily perplexing problems in an engineer's life is acquired.

State College, Pa.

would place the mind in complete control of.

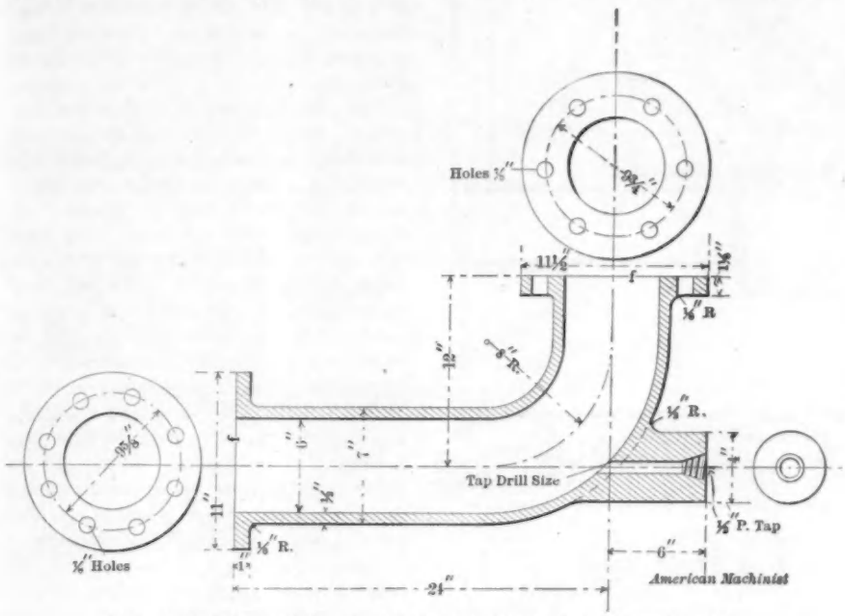
While harping upon this subject of system in making and preserving records, system in placing dimensions on drawings is not irrelevant. This is a well worn subject, and the right and wrong ways have been again and again under discussion. One thing is certain, however, and that is that it is right to have a drawing completely dimensioned, and wrong if all the dimensions are not on. There is no question of degree here, for completeness idea that a drawing is not figured completely until every part of every detail is dimensioned. Until the systematic patient review of line after line is realized to be the only possible solution, so long do the drawings come in but half dimensioned. Also since no system of work has been used, the existing dimensions are liable to be widely separated where they should be grouped, and *vice versa*.

Putting dimensions on a drawing is not a knack. If it is, it is a cultivated knack. It is the result of a system whereby every

The Mechanical Devices of an Ancient Illuminator.

BY R. I. CLEGG.

Among the beautiful creations of the past must be counted the manuscripts of the penmen of the early centuries of the Christian era. Illuminating was indeed a comprehensive term to apply to their business, which included painting and the manufacture of inks and pigments, as well as the building of machines. It is with this latter pursuit, of course, that my interest mainly lies, and quite unexpectedly I have run across, in an old work on "The Art of Illuminating," a translation of a portion of the writings of Rugerus, or Theophilus, by Mr. Robert Hendrie. Rugerus was a monk, and contemporary with the date of the Norman Conquest of England; as a penman he was held in high repute, and several of the great libraries have copies of his works, and as machinist and molder he was not an unworthy craftsman, as you may judge.



ILLUSTRATING METHOD OF MARKING DIMENSIONS ON DRAWINGS.

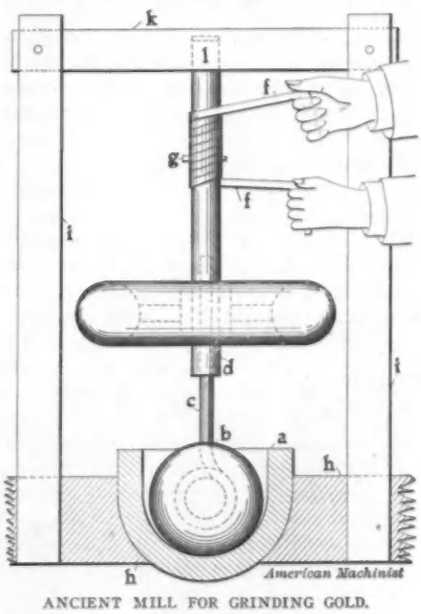
In his Chapter XXX he deals with the subject "Of grinding gold for books, and of casting the mill." "When you have traced out figures or letters in books, take pure gold and file it very finely in a clean cup or small basin, and wash it with a pencil in the shell of a tortoise, or a shell which is taken out of the water. Have then a mill with its pestle, both cast from metal of copper and tin mixed together, so that three parts may be of pure copper and the fourth of pure tin free from lead. With this composition the mill is cast in the form of a small mortar, and its pestle round about an iron in the form of a knot, so that the iron may protrude of the thickness of a finger, and in length a little more than half a foot, the third part of which iron is fixed in wood carefully turned, in length about a yard, and pierced very straightly; in the lower part of which, however, of the length of four fingers from the end must be a revolving wheel, either of wood or of lead, and in the middle of the upper part is fixed a leather strap, by which it can be pulled and, in revolving, be drawn back. Then this mill is placed in a hollow, upon a bench fitted for it, between two small wooden pillars firmly fixed into the same bench, upon which another piece of wood is to be inserted, which can be taken out and replaced, in the middle of which, at the lower part, is a hole in which the pestle of the mill will revolve.

"These things thus disposed, the gold, carefully cleansed, is put into the mill, a little water added, and the pestle placed, and the upper piece of wood fitted, the strap is drawn and permitted to revolve, again pulled, and again it revolves, and this must be so done for two or three hours. Then the upper wood is taken off and the pestle washed in the same water with a pencil. Afterwards the mill is taken up, and the gold, with the water, is stirred to the bottom with the pencil, and is left a little, until the grosser part subsides; the water is presently poured into a very clean basin, and whatever gold comes away with the water is ground. Replacing the water and the pestle, and wood above being placed, again it is milled in the same way as before until it altogether comes away with the water.

"In the like manner are ground silver, brass, and copper. But gold is ground most carefully, and must be lightly milled; and you must often inspect it, because it is softer than the other metals, that it may not adhere to the mill or the pestle, and become heaped together. If through negligence this should happen, that which is conglomerate is scraped together and taken out and what is left is milled until finished. Which being done, pouring the upper water with the impurities from the basin, wash the gold carefully in a clean shell; then pouring the water from it, agitate it with the pencil, and when you have had it in your hand for one hour, pour it into another shell, and keep that very fine part which has come away with the waters. Then again, water being placed with it, warm it and stir it over the fire, and, as before, pour away the fine particles with the water, and you may act thus until you shall have purified it entirely. Afterward take the bladder of a fish called huss (sturgeon) and washing it three times in tepid water, leave it to soften a night, and on the morrow warm it on the fire, so that it does not boil up, until you prove it with your finger if it adhere strongly and the glue is good."

Further on in his treatise the learned ecclesiastic describes minutely the burnishing of the golden inscription; "with a tooth or bloodstone, carefully filed and polished upon a smooth and shining horn tablet." The "pencil" was a small brush, and, by the way, I may state that during the past week I have witnessed the filing of silver with a fine file and the separation of the larger from the finer particles with a camel's hair brush exactly as described by the old author some nine centuries ago: and his suggestions on the burnishing of gold are just as closely adhered to in present day practice.

The sketch is simply my view of the machine described by Rugerus: *a* = the mill or mortar, and *b* the pestle; *c* is the iron with a knot at end on which *b* is cast and firmly retained; *d* is the "carefully turned wood"; *e* is the fly-wheel; *f* is the strap fastened to *d* by the peg *g*; *h* is the hollowed bench; *i i* are the supports fixed in *h* and slotted at their upper ends to hold *k* by the pegs shown; *l* is the bearing for *d*, and is deep enough to permit a short upward movement of *d*.



ANCIENT MILL FOR GRINDING GOLD.

The proportions of the alloy agree closely with those given by modern experts for gong metal; and, furthermore, the centrifugal action utilized seems to anticipate some patented disintegrating machinery and perhaps we may claim no more; although, after reading of ball bearings that are so designed that they can have none other than a grinding action, we may feel that in this, too, the old writer was a pioneer. His measurements are not certainly to B. & S. refinements, but beyond any argument they are of a handy character.

Providence, R. I.

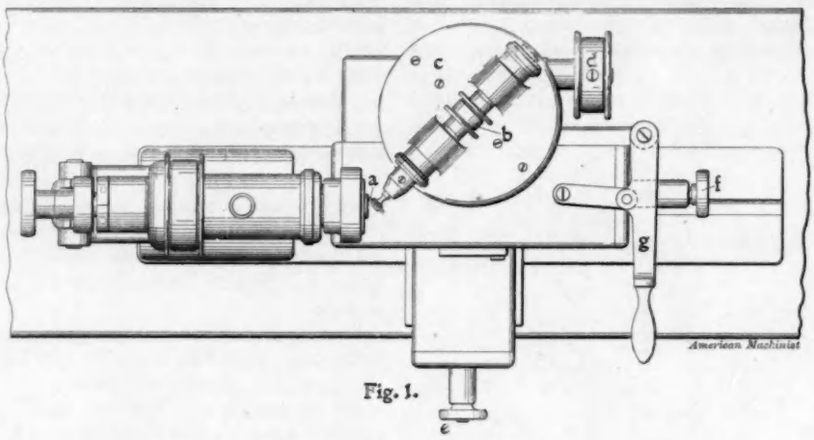


Fig. 1.

PLAN OF GRINDING MACHINE.

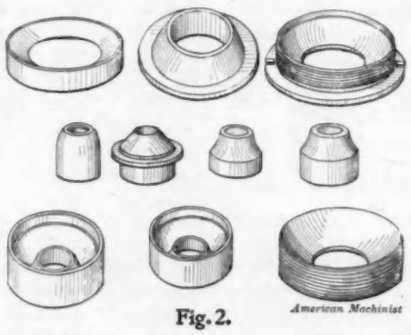


Fig. 2.

WORK FOR WHICH MACHINE SHOWN IN FIGS. 1 AND 16 IS ADAPTED.

Bicycle Cup and Cone Grinding Machines.

The accompanying illustrations show some very novel machines for the grinding of the cups and cones of bicycle and similar ball bearings which have recently been developed by the Pratt & Whitney Company, of Hartford, Conn.

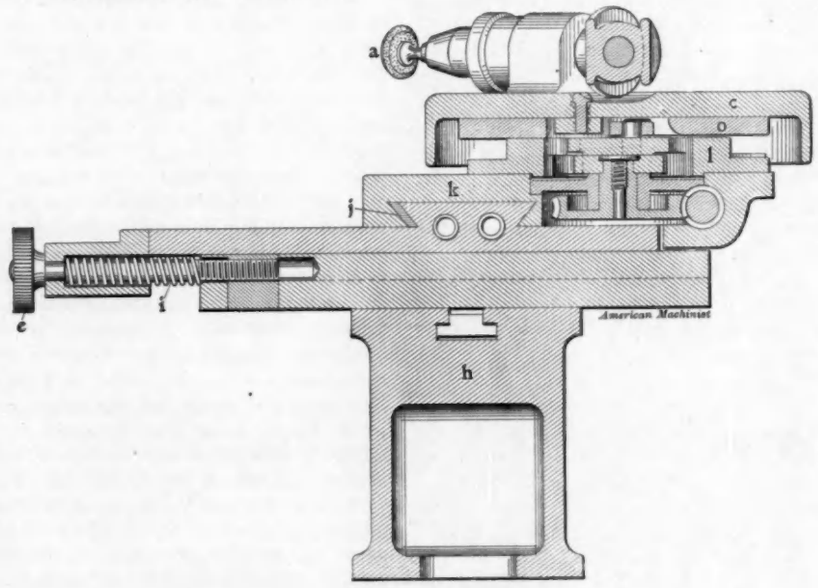
These machines are, speaking broadly, an application of regular grinding machine principles to the grinding of curved surfaces. That is, the emery wheel is reciprocated automatically over the work with cross feed adjustment of the wheel by hand. The essential difference is that the wheel, instead of moving in a straight line as in ordinary grinding, follows a curve suitable to the profile or section of the ball race—this curve being adjustable, within the limits of bicycle ball bearings, to conform to the profiles of different makers.

The machines as a whole take several forms, according to the class of work to be done—that is, according to whether cups, cones, hubs, or shafts are to be ground—but in all of these forms the characteristic and essential feature is the grinding head or rest by which the curved outline is obtained, the machine as a whole being built around this to accommodate the work provided for.

Fig. 1 represents the machine in plan as adapted to the grinding of separate cups and cones, such as are shown in Fig. 2. The head stock of the machine will be seen at the left, arranged to take the work by means of a draw-in or collet chuck which is operated by a foot treadle. The emery wheel will be seen at *a*, its spindle being located at an angle with the work spindle. The grinding spindle pulley will be seen at *b*. This spindle runs in bearings which are mounted on a circular base plate *c*, and through the reciprocation of this plate through the pre-determined curve, the wheel is guided in a similar curve. The reciprocation of the wheel is effected by the belt pulley *d*, the machine being thus seen to have three driving belts like other grinding machines, namely, one for the work, one for the emery wheel, and one for the reciprocatory motion.

In addition to these movements the wheel has the necessary movements for adjustment by hand. Thus the knurled head *e* adjusts it crosswise of the bed for the cut, head *f* adjusts it lengthwise, and lever *g* provides for withdrawing it from the work for gaging or for the insertion of a new piece without disturbing the adjustments.

The reciprocation of the wheel in a curved path is by the ingenious mechanism shown in Figs. 3, 4, 5, 6, 7, and 8, of which Fig. 3 is a cross section perpendicular to the center line of the bed and through the wheel carriage. The wheel will be seen at *a* and the bed at *h*. The entire carriage is bolted to the bed by T-slotted bolts, as indicated. The screw for hand adjustment crosswise of the bed will be seen at *i*, while the slide on which the lengthwise adjustment is made is shown at *j*. Mounted on the sliding member *k* and secured rigidly to it is the base piece *l*, seen also in Fig. 4. This piece has guide ways *m n* on its upper surface, in which the piece *o*, Figs. 3 and 5, may slide parallel with the line of the emery wheel spindle. This piece *o* has in turn slide ways *p q* on its upper surface at right angles with the previous line of movement. Above this piece the circular base *c*, Figs. 1, 3, and 6, is fitted, two blocks, *r s* Fig. 6, fitting the slide ways *p q* of piece *o*. The emery wheel may thus move in line with its spindle or at right angles therewith, in accordance with the slide



CROSS SECTION OF MACHINE.

operated. The sliding lengthwise of the spindle is accomplished through a cam *t*, Fig. 7, which is rotated through the worm gear *u*, Fig. 7, and pulley *d*, Figs. 1 and 7. This cam compels the piece *o* to recipro-

cate in line with the grinding spindle through the pins which straddle it, these pins being attached to the lower side of piece *o*, as seen in Figs. 5 and 7. Were the circular base *c* rigidly connected to *o*, the wheel would also so reciprocate. Through the cross slide ways *p q* of piece *o*, Fig. 5, and the blocks *r s* of piece *c* which fit the ways *p q*, the spindle may move perpendicularly to its axis, and through the former *v*, Figs. 6 and 8, attached to the under side of *c* and the roller pin *w*, Figs. 4 and 8, attached to the upper side of *l*, it is obvious that the grinding spindle and wheel will also have a motion perpendicular to their axis, and by suitably shaping the former *v* the movement of the wheel may be made to

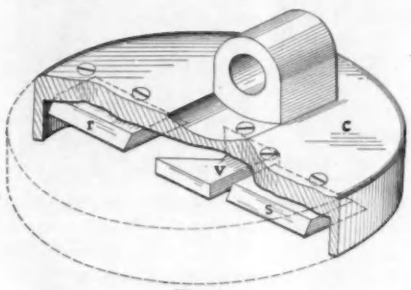


Fig. 6.

EMERY WHEEL BASE WITH SLIDES AND FORMER.

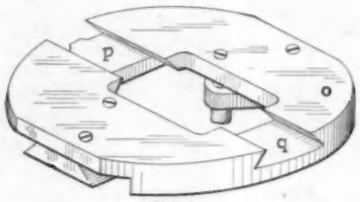


Fig. 5.

LONGITUDINAL SLIDING MEMBER.

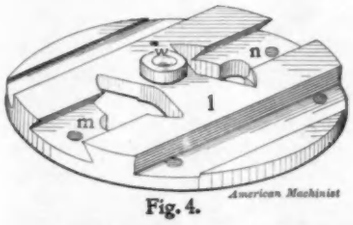


Fig. 4.

BASE PIECE OF MOVEMENT.

produce such a curve as is desired for the bearing. It will be noticed that while the cam *t* drives the spindle by a positive motion in both directions the former cannot do this, and to insure contact with the former a spring *x*, Fig. 8, is provided.

The mechanism described, by variations in the outline of the former *v*, is obviously capable of grinding ball races of any radius as well as the straight approaches to the races. It fails, however, in the case of races having returning curves or ball retainers, as with it it is obviously impossible to grind an outline of which one part returns in direction upon itself. For such cases the construction shown in Figs. 9 and 10 is employed. In this arrangement both slides are operated by revolving cams. Comparing Figs. 9 and 3, the worm wheel shaft will be seen to carry two cams *t* and t_1, the former of which actuates the lower slide, while the latter actuates the upper, contact with the cams

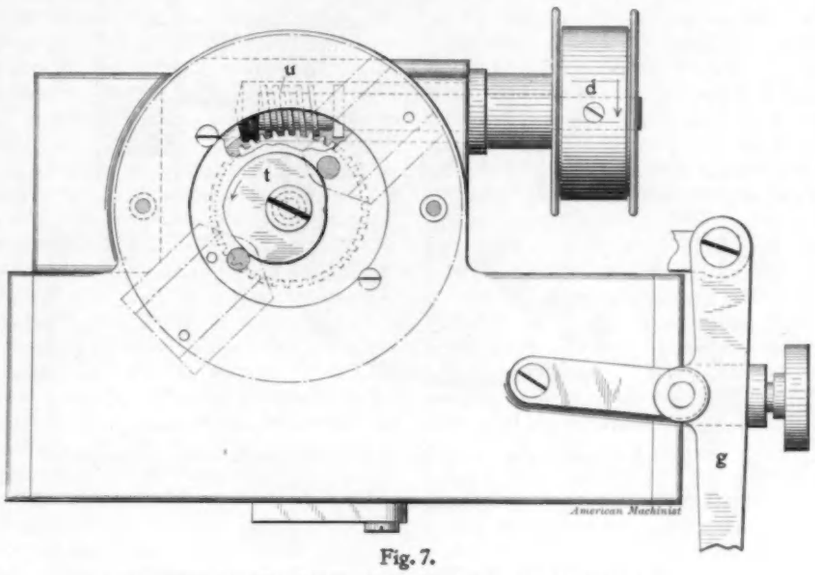


Fig. 7.

MECHANISM FOR LENGTHWISE RECIPROCATION OF SPINDLE.

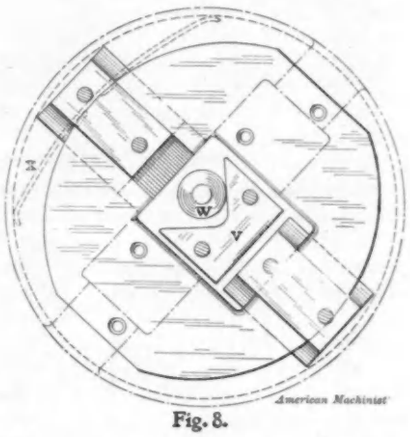


Fig. 8.

MECHANISM FOR CROSSWISE RECIPROCATION OF SPINDLE.

for the return movement being insured by a spring *y*, Fig. 10. It is obvious that with this construction any path of travel of the emery wheel, even to a complete circle, is possible. The piece being ground in Fig. 10 has a ball retainer, and it is clear from the figure that for this class of work conical wheels are necessary.

For the grinding of bicycle cups very small wheels are necessary, and to give these the necessary peripheral speed the speed in revolutions must be correspondingly high. The speed for which these spindles are belted is in fact no less than 28,500 revolutions per minute, and the construction of bearings capable of enduring such a speed continuously is at once a matter of interest. The bearings are in fact ball bearings of the two-point type, and with a separating member to keep the balls apart. Fig. 11 shows a longitudinal and Fig. 12 a cross section of the spindle and bearings, and Figs. 13, 14, and 15 show the floating ball separating ring which is made of vulcanized fibre. The number of balls to the bearing will be seen to be but five. These spindles run for hours at a time with the development of a little warmth only. A little vaseline is used for a lubricant—too much of it being attended with the generation of more heat.

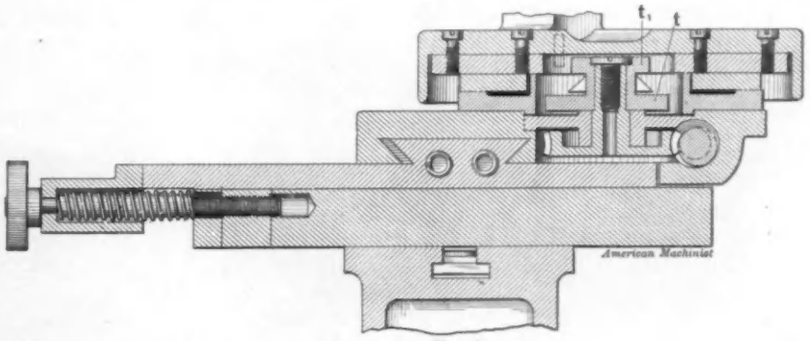


Fig. 9.

SECTION OF DOUBLE CAM MECHANISM.

A test of these bearings for durability has been made by running them for an entire week of 59 hours and then comparing

the size of the balls before and after the test. Measured in this way by the most refined measuring appliances of the Pratt & Whitney Co.—which are equal, as is away of a leather belt from the pulley is due to the air carried along with the belt, which at very high speeds is unable to escape from under the belt with sufficient force may be so reduced as to play an important part. Certainly the difference in the action of leather and tape belts under extremely high speeds is very marked.

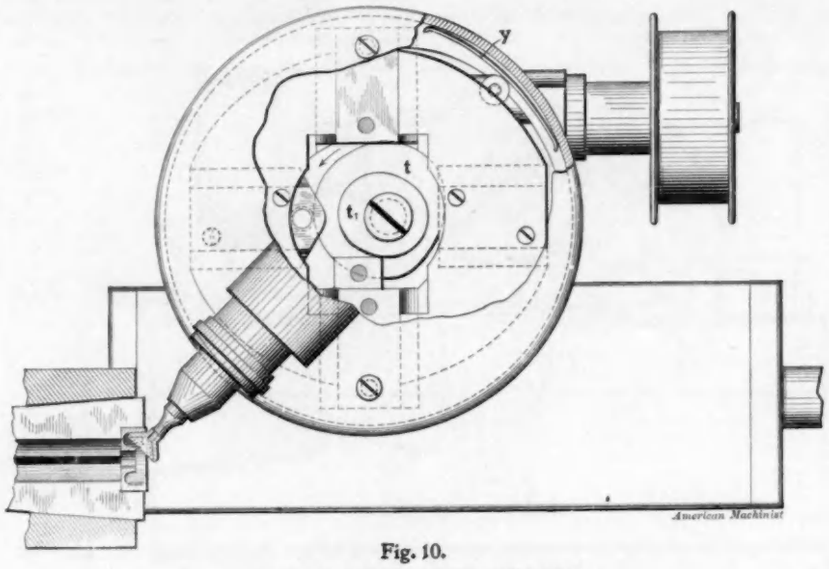


Fig. 10.
PLAN OF DOUBLE CAM MECHANISM.

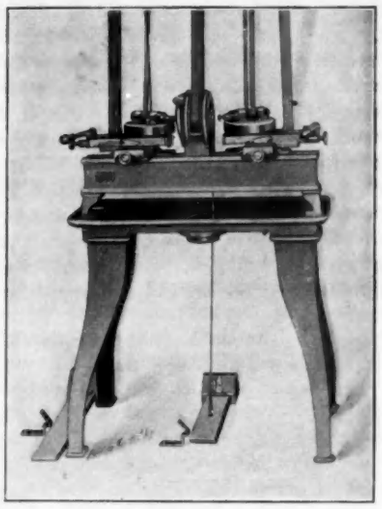


FIG. 17. MACHINE ARRANGED FOR GRINDING HUBS.

well known, to any in the world—no wear whatever could be detected.

The attainment of speeds of 28,500 revolutions per minute is an unusual occurrence, and there are not wanting those who are severely skeptical about the possibility of obtaining such a speed, or anything approaching it, through the medium of belting. The action of belting at high speed on small pulleys, by which it curves away from the pulley on the approaching side, is well known. Such action, of course, largely reduces the contact of the belt with the pulley, and correspondingly reduces the driving power, which finally becomes insufficient to overcome even the friction of ordinary bearings. The use of ball bearings of itself goes far to reduce the difficulties in the way, and the use of a tape belt accomplishes the rest. With such a belt—as we can testify from personal observation—the belt does not curve away from the pulley at all, but hugs it as

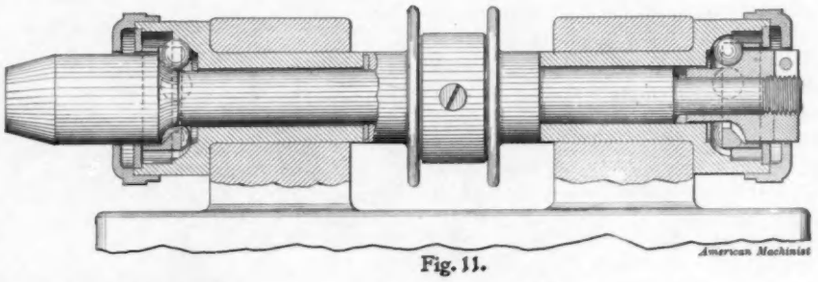


Fig. 11.

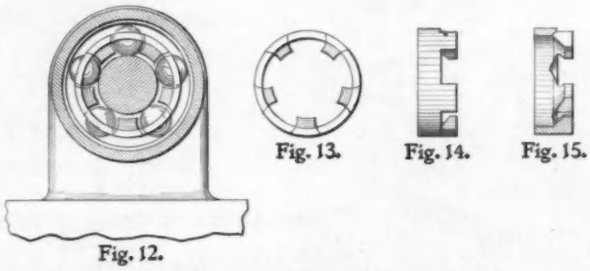


Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

GRINDING SPINDLE AND BEARINGS.

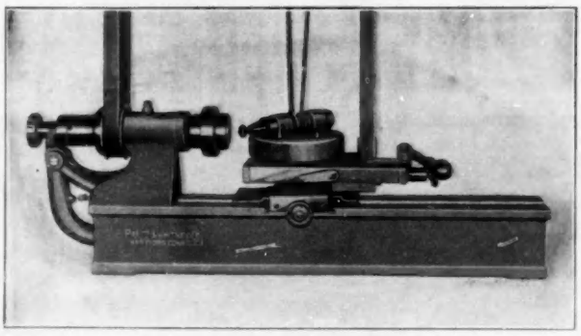


FIG. 16. MACHINE ARRANGED FOR GRINDING DETACHED CONES.

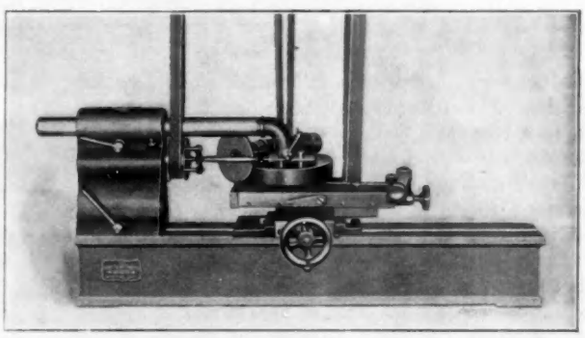


FIG. 18. MACHINE ARRANGED FOR GRINDING AXLES AND PEDAL PINS.

it would at ordinary speeds. This action of the tape belt is attributed by the Pratt & Whitney Co. to the porosity of the belt material. They consider that the curving promptness to permit contact with the pulley. It is possible also that the tape belt being so much lighter in weight than one of leather, the action of centrifugal

As stated in the beginning, the machine is supplied in several forms or "combinations" as they are called by the makers. Fig. 16 is from a photograph of the com-

bination already shown in the line engravings, and is for the production of pieces such as those shown in Fig. 2. Fig. 17 shows the arrangement for grinding wheel hubs which are so mounted that both ends are ground at the same time through the use of two grinding rests. Fig. 18 shows the arrangement for grinding axles and pedal pins. The grinding rest will be seen to be the same in all the combinations. Other combinations for plain or straight grinding are also provided.

In Figs. 16 and 17 the work is held in collet chucks which are operated by a foot treadle. Depressing the treadle first ships the work driving belt to the loose pulley, then opens the chuck and applies a brake to the work spindle, so that it stops immediately. On a new piece being inserted and the treadle released the work is gripped and the machine started again.

The Judges' Report on Motocycles at the Boston Show.

The judges' report on the mechanically-driven wagons exhibited at the triennial exhibition of the Massachusetts Charitable Mechanic Association of 1898 is at hand.

This report is evidently written without an intimate technical knowledge of automobilism; but, for all that, it shows that the writer had perfectly clear, correct, and well-defined ideas as to the essentials of successful mechanical transportation on common roads; and this report is consequently of real interest.

The exhibits of motor wagons at the fair were as follows:

1. The Pope Manufacturing Company, Hartford, Conn., two four-wheeled electrics, and one four-wheeled gas-engine-driven parcels carrier.

2. The Riker Electric Company, Brooklyn, N. Y., one four-wheeled electric phæton, one electric tricycle, and one electric delivery wagon.

3. The Eaton Electric Motor Carriage Company, Boston, Mass., one electric "Stanhope."

4. The Whitney Motor Wagon Company, Boston, Mass., two steam wagons.

5. The De Dion & Bouton Company, Paris, France, one four-wheeler and two tricycles, gas-engine driven.

No wagons are mentioned in this report which were not entered as exhibits at the fair.

The points considered by the judges were: 1, Speed; 2, manageability; 3, simplicity of construction; 4, durability; 5, appearance; 6, brake efficiency; 7, range of speed; 8, comfort; 9, cost of operation; 10, hill climbing.

The judges say, in a preamble to their report, that excessive speed is not desirable, and fix the maximum rate for road work at 15 miles per hour, saying that more than fifteen miles is not needed, except for racing wagons.

But the judges also notice the very important and not fully understood essential of ability to increase power for hill climbing, so that the mechanical wagons can go up hill faster than horse-drawn wagons, and they say, in addition, that motocycles can always be faster than horse-drawn wagons of equal safety, because they can be the better and more certainly guided. Hence a great range of speeds is very desirable, and the ability to run backward is also mentioned as needful.

In remarks on manageability the judges' report says: "This is a matter of the greatest importance. By 'manageability' is meant that the carriage should be easily turned, quickly started and quickly stopped, and easily guided where room is small, as in a crowd of vehicles or in a very narrow street; also, that in cases where it is necessary to turn quickly, to turn in a small space, or to reverse or go ahead at any speed, these things can be readily done. All this is very necessary in order that obstacles, whether at rest or in motion, may be easily and quickly avoided."

It should be observed, however, that all the motor carriages exhibited are decidedly more manageable than a horse-drawn carriage, as they occupy less room, and the driver guiding a motor-carriage knows just what it will do, with far greater certainty than the driver of a horse knows what the horse will do.

In regard to simplicity of construction the judges are slightly contradictory; they demand simplicity of mechanism to avoid derangement, to avoid delicate adjustment, to avoid the necessity of a skilled mechanic for a driver, and to permit the making of repairs with ordinary tools.

In point of fact, the more completely self-regulating the mechanism is, the less the skill demanded on the part of the driver. For example, the Stanley steam wagon, with its highly organized steam production governing devices, demands far less skill and attention on the part of the driver than the Whitney steam wagons shown at the fair, which did not have the fire controlled by the steam pressure, and which therefore demanded the constant attention of a really skillful engineer.

Durability does not necessarily go with simplicity, nor is complexity sure to cause an early demand for repairs. A plain bearing is infinitely more simple than a ball bearing in, say, a bicycle crank hanger; yet it is well known, and amply proved by use in the case of wholly unskilled riders, that ball bearings of a good design, operated under moderate loads, are far more durable than plain bearings. It seems quite certain now, that the finally accepted types of motocycles will have very highly organized motors, involving intricate complexities of mechanism, because such motors can take care of themselves, and so make but small demands for mechanical knowledge and expertness on the part of their drivers.

In regard to appearance and design the judges say, after some qualifications, "Nevertheless, in all cases neatness and elegance of design are important."

This report notes the necessity of ample brake power, and of comfort for the riders, and then, under "Cost of Operation," says that this item is so small, being less than two cents per mile with any vehicle shown, and so much below the cost of horse traction, that the difference in power cost of different vehicles is not likely to greatly influence the purchaser in his choice of a vehicle. While this may be true in regard to pleasure carriages or private conveyances, it is very certain that fuel cost will form an important feature in wagons which are operated for hire, or which carry heavy loads. When commercial work is to be done by the motocycle a saving of five-sixths of the motive power cost will be a distinct factor in making sales, and there was shown at Charles River Park a motor wagon which could carry two passengers for one-third of a cent per mile for fuel cost, instead of the two cents per mile for current which the heavy electrics demand.

Coming to the Charles River Park contests, the first was for speed, the contestants being the three De Dion gasoline wagons, two Whitney carriages, and the Boston Haynes-Apperson gasoline wagon. A De Dion & Bouton tricycle was the winner, making two miles on a 3-lap track in 5:01⅗, and taking the first prize of $500.

The second prize, $150, went to one of the Whitney steam wagons, driven by Mr. Whitney himself.

In the brake efficiency trials there were four contestants, a De Dion tricycle, the Haynes-Apperson wagon, the Riker electric phæton, and a Whitney steam wagon. The Riker electric took first money, $100, and the Haynes-Apperson the second prize, $50.

The "Manageability" contest was made under conditions which rendered it impossible for a four-wheeled vehicle to win against a tricycle, and, as was a foregone certainty, first money, $100, went to one of the De Dion tricycles. The second money went to the heavy Riker phæton, much to the surprise of Mr. Riker himself, who was driving.

The hill climbing was on a built-up structure, 80 feet long, which, starting from the level, varied its inclination by successive increments of 5 degrees each up to an angle of 36 degrees at the upper end.

The Haynes-Apperson, the Riker phæton, a De Dion four-wheeler, and a Whitney steam wagon entered this trial. The Whitney steam wagon took first money, $100, travelling 76 feet 8 inches on the hill, with a horizontal run of 20 feet before reaching the beginning of the

grade. The Riker phæton took second money, $50, with the same start and a run on the grade of 62 feet 7 inches. The Haynes-Apperson ran 51 feet 5½ inches on the hill, and the De Dion & Bouton four-wheeler ran up 40 feet 4¼ inches. The Whitney wagon stopped on a grade of 36.4 degrees, the Riker on the 28.7 degree grade, the Haynes-Apperson had its fore wheels on the same angle, while the De Dion stopped at the 21.3 degree angle.

Neither the Pope nor the Eaton wagons took any part in the contests. The Eaton was only about six or eight weeks old from its commencement, and was not fully completed.

The judges praise the elegance and comfort of the electric wagons, and particularly commend Whitney's very ingenious steering lever, by means of which a single handle is made to control all the movements of his steam wagons, and also mention Whitney's manageability and hill climbing with approval.

The judges pronounce the De Dion tricycles very ingenious and well calculated for use where a small and light vehicle is desired, and say that the Haynes-Apperson is of good general appearance, is easily controlled, a good hill climber, and well adapted for a variety of purposes.

Taken altogether, this report is strong in evidence of a general and accurate comprehension on the part of the public of the real requirements of the successful motocycle, and of the widespread interest excited in this country by mechanically propelled vehicles.

HUGH DOLNAR.

Diagram for the Design of Shafts.

BY G. EUGENE BARRETT.

The accompanying diagrams represent curves plotted to assist in determining the diameter of a solid shaft when the bending and twisting moments are known. They are plotted from a well-known formula, and the method used in finding the equivalent twisting moment is old, though the writer has no knowledge of ever seeing it plotted in a curve, where it could be easily handled and save a great deal of calculation. It has been in use for a few years on a varying class of work, and found to be a great time saver.

To find the equivalent twisting moment of a shaft when the bending and twisting moments are known we use the formula:

$$T_1 = M + \sqrt{M^2 + T^2}$$

in which T_1 = the equivalent twisting moment, M the bending moment, and T the twisting moment.* The calculation involved in using this formula, if a table of logarithms is not handy and the moments are large, is laborious. By the use of the curves which I have drawn we simply have to find the ratio between the bending and twisting moments, then obtain a constant, with which we multiply the twisting moment and obtain the equivalent twisting moment.

Let T_1 = equivalent twisting moment.
M = bending moment.
T = twisting moment.

Then $T_1 = M + \sqrt{M^2 + T^2}$ (1)

Let $\frac{M}{T} = P$ (2)

Then $M = TP$.

Substituting the value of M in formula (1) we have:

$$T_1 = TP + \sqrt{T^2 P^2 + T^2}$$
$$= TP + T\sqrt{P^2 + 1}$$
$$= T(P + \sqrt{P^2 + 1})$$

Now let

$$P + \sqrt{P^2 + 1} = R$$

and we have:

$$T_1 = TR, \quad (3)$$

which is (1) in a reduced form.

If values be assigned to P, R can be easily calculated and a curve plotted from which the value of R can be easily read when the ratio between the bending and twisting moments is known.

I have also plotted curves that will readily give the diameter of a solid shaft, when the equivalent twisting moment is between 40,000 inch-pounds and 15,300,000 inch-pounds, curves for fibre stresses of 9,000 pounds and 6,000 pounds per square inch being also given.

I used the formula $d = 1.72\sqrt[3]{\frac{T}{S}}$ in plotting these curves, which was obtained as follows:

Let T = equivalent twisting moment.
S = fibre stress.
J = polar moment of inertia.
c = distance from the neutral axis to the outermost fibre.
$\pi = 3.1416$.
d = diameter of the shaft in inches.

Placing the two moments equal to each other we have:

$$T = \frac{SJ}{c} \quad (4)$$

For a solid shaft $J = \frac{\pi d^4}{32}$

For a solid shaft $c = \frac{d}{2}$

whence $\frac{J}{c} = \frac{\frac{\pi d^4}{32}}{\frac{d}{2}}$

$$= \frac{\pi d^3}{16}$$

Substituting the value of $\frac{J}{c}$ in formula (4) we have:

$$T = S\frac{\pi d^3}{16}$$

Solving for d we get:

$$d = \sqrt[3]{\frac{16\,T}{\pi S}} = 1.72\sqrt[3]{\frac{T}{S}}$$

By having both curves on the same paper we can very easily find the diameter of a shaft, when the bending and twisting moments are known.

An example will best serve to make plain their use.

Let a solid shaft be designed to stand a twisting moment of 3,000,000 inch-pounds and a bending moment of 2,500,000 inch-pounds. By referring to formula (2) we find that $P = \frac{M}{T} = \frac{2500000}{3000000} = 1.2$.

Now from the curve, the value of R corresponding to $P = 1.2$ is found to be 2.75. Placing this in formula (3) gives: $T_1 = 3{,}000{,}000 \times 2.75 = 8{,}250{,}000$ inch-pounds.

Finding this value of T, at the left, and tracing to the right to the desired curve for fibre stress—say 9,000 pounds—we find 16.7 inches, the diameter of the shaft, immediately below the intersection, or, for a fibre stress of 6,000 pounds we find the diameter to be 19.2 inches.

*See Unwin's Elements of Machine Design, Vol. 1, page 91.

The Status of the Engineer.*

BY J. S. WALKER.

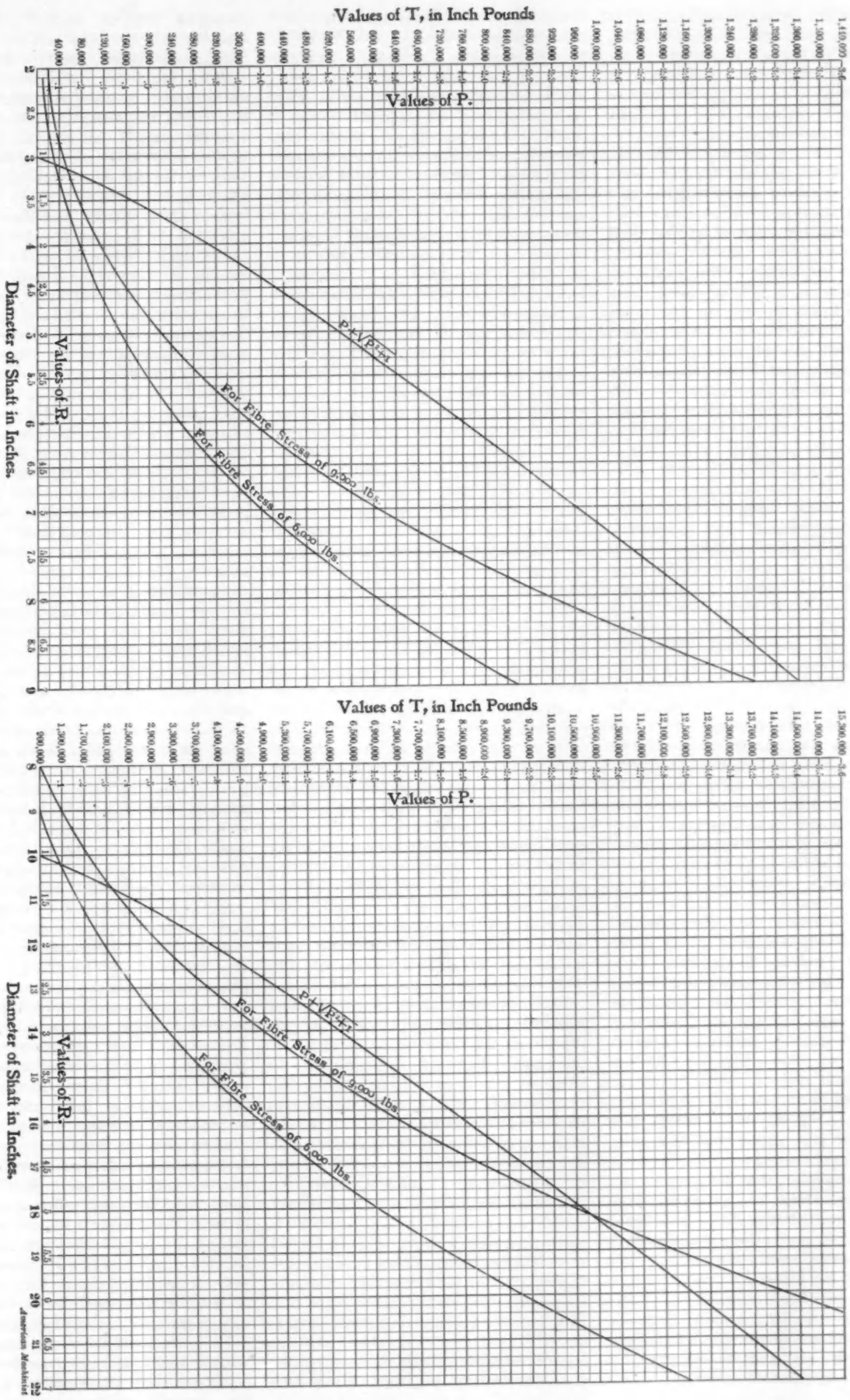
At different times we hear much about the status of engineers, and of the low esteem accorded them in comparison with that of other professional men; and while I recognize the fact as freely as do those who make the complaints, I am free to confess I believe that, as a profession, we get about all that we deserve in the way of praise and regard.

Many panaceas have been urged from time to time as a remedy, and the one most in vogue to-day, as it was fifty years ago, is greater scientific training. I wish to state here at the beginning of my remarks that there is no one more thoroughly convinced of the importance of proper scientific training than I am.

The skill and the ability of the majority of any body of men, rather than the genius of the few great ones, determine the standing of that body; and this applies equally to farmers, lawyers, doctors, and preachers as it does to engineers. Now, what is the nature of the work the vast majority of us find ourselves called upon to perform? Is it something of great magnitude, requiring original research and new application of scientific principles; or is it of ordinary proportions, requiring ready knowledge of well-known laws of nature, ordinary commercial products and machines, capacity for deciding, care, honesty, and sound, practical judgment? You all see at once that the vast majority of engineers find their life work in the second category, while those who design the great works find 90 per cent. of their lives spent in the same character of duties as falls to the majority.

When we look at our imposing bridges, steamships, water works, and other works of the engineer, we must constantly bear in mind that it was the work of untold and unknown engineers, who have each,

*Annual address, slightly abridged, of the president of the Engineering Association of the South; Nashville, Tenn., Nov. 10, 1898.


Values of T, in Inch Pounds
Values of P.
Values of R.
Diameter of Shaft in Inches.
For Fibre Stress of 9,000 lbs.
For Fibre Stress of 6,000 lbs.
Values of T, in Inch Pounds
Values of P.
Values of R.
Diameter of Shaft in Inches.
For Fibre Stress of 9,000 lbs.
For Fibre Stress of 6,000 lbs.

DIAGRAMS FOR FINDING DIAMETERS OF SHAFTS IN INCHES.

through many failures, adding a little here in theory and more there in practice, made possible the structures as we see them to-day. Sound, practical judgment, as important to-day as in the days of George Stevenson, shows itself in all these structures we admire.

When we come to examine in detail the present practice of engineering, we cannot fail to see the overpowering influence exerted by practical considerations. Take plate girders, for instance. When they were first used in this country, their webs were made much thinner than good practice now sanctions. The increased thickness given to the webs is not due to any theoretical considerations, but is due to the fact that, in using plate girders, experience taught that it was necessary to give an increased thickness to the webs, to provide against the deterioration of the metal and the rusting caused by coal smoke, and also to increasing the bearing surface for rivets. Concrete, for dock walls in England, was first used on account of a strike among the stone cutters, and the cheapening of Portland cement and immense gravel deposits in the Thames accounts for its use in the docks of the port of London. Practical considerations are well-nigh paramount in controlling the design of the details of machinery, and where practical considerations no longer control, the details are determined by experience. I know it is the fashion to extol science at the expense of the practical, but our employers go on pinning their faith to practical men and making us their subordinates. I know many mechanics, whom you would pass by and call practical men, yet who in their line of business have as thorough a knowledge of what constitutes good construction as any engineer has; knowing good, suitable material from bad; knowing the proper tools and plant to use, and controlling a working force to perfection. This is not to be wondered at, for all the knowledge necessary from books can be easily had, and usually in plain English. Some of the most valuable knowledge I have ever acquired has been from such men, and I would be a very contemptible fellow not to acknowledge it. Our employers know many men and their capabilities, and when we see the practical man superseding the engineer, it is generally found to be another case of the survival of the fittest.

Every engineer should have all the scientific knowledge or education he can get in his teens; but it should be confined to a few things thoroughly understood, rather than, as is too often the case, to a superficial knowledge of many things; and then he should acquire the workman's knowledge of the materials, tools, and plant he will have to use, and acquire the foreman's ability to control and manage the working force.

I must confess that the English method of training engineers seems to me the ideal one, when it is preceded by a fair education, and unless we wish to be regarded as simply a refined kind of surveyor, or draftsman, it, or a very similar one, is the method we must pursue, so as to be able "to direct the great sources of power in nature to the uses and convenience of man." The subdivision of labor has gone so far that there must be some one to direct and guide the different units, and the engineer, by his experience and training, must be that man, if we really wish to have that standing in the eyes of the public which we now complain is lacking. Human labor is as much a power in nature as steam, and as engineers we should not relegate its management entirely to the contractors. When I hear an engineer express fears as to a piece of work having to be done by day's labor, I know that there has been a big something lacking in his training.

In examining any subject, it is always wise to begin our investigations by studying its beginnings. When judged in this way, many things we consider very modern and up to date, will be found to be old. The modern engineer had his beginning when Watt made the use of steam, as a prime mover, practicable. Very few of us realize the debt we engineers owe to James Watt, not only for his inventions, but for his methods in attaining them, and the study of his life and works will be time well spent for all of us. During my active life, the stadia has come into use for surveying; but none of those who write books have given the proper credit for its introduction. They all go to Italy and give Gen. Porro the credit for its introduction, while if they had carefully read the life of Watt, they would have found that Watt employed on the surveys of the Crinan and Gilp, in 1771, and on the survey of the Caledonian Canal, in 1773, what he called his micrometer for measuring distances, but we now call it the stadia. In no modern book do we find it any better described than Watt described it.

The advances made in engineering from the introduction of the steam engine to the date of the successful trial of Stevenson's locomotive, the Rocket, in 1829, were truly wonderful. However, since the day of the trial of the Rocket, the advance in every department of engineering has been greater than during all the rest of the earth's existence. A very natural question to ask would be: To whom are we indebted for the initiative in this vast movement? To the English-speaking people we are indebted for the steam engine, the steamboat, the railroad, the locomotive, the self-acting lathe, the planing machine, the hydraulic press, and, with but few, and unimportant exceptions, all the other shop tools and appliances which have rendered possible the transformation of the raw material into the finished product—Portland cement, Bessemer steel, the electric telegraph, the telephone, the iron steamer, the sewing machine, the reaping machine, cheap watches and clocks, the typewriter; and this list could be extended to take in nearly every appliance and device for the comfort of the masses. In looking over this vast field, I can pick out only two devices in common use, furnished in the past century by other than an English-speaking man, which it would be inconvenient to do without, and these two devices are the Bourdon pressure gage and the injector. While it is true that self-interest has been at the bottom of all this development, each and every one of the above mentioned devices and discoveries has tended to ennoble and better mankind. The people of the United States have done much of this, either in the initiative or in improvements; but it is an incontrovertible fact that the first steps in this vast modern field of engineering were made in the island of Great Britain. To its people is due the credit of being able "to direct, in an economical way, the great sources of power in nature to the uses and convenience of man," and their kin across the seas have bettered the instruction. The kind of men to do all these things it becomes us to find out, seeing that we are engaged in the same field of work. Take Watt, the Stephensons, Fulton, Maudsley, Nasmyth, Brunel, Elder, Bessemer, Morse, Edison, and all those others who have contributed to this movement, and what kind of men do we find them? Each and every one of them were men with the mechanical instinct, and keen observers of nature in her various aspects. They and their assistants and coworkers are trained by actual contact with their work. Practical tact, ability to decide, knowledge of men, the control and direction of labor, sound judgment, the workman's knowledge of methods and materials, and enough science and mathematics simply for their daily needs, constituted the professional equipment of that vast army of English-speaking engineers who in the last seventy years have worked out our modern industrial problems and forced the supremacy of the Anglo-Saxon race. The savants have originated little, and their mental habit is such that they cannot direct; still our debt to them is very great, and we cannot do without them. But when we come to educate the rising generation of engineers, I, for one, fear that we may have them too much educated and refined for the work they are to do; and it is more than probable that the great schools, with their refined and extended courses on subjects which are only truly taught by actual experience, while they may help and assist to train, will be found as not tending to elevate the great mass of engineers.

The public in a free country knows what it wants, and when we find the so-called practical man given the preference over engineers for work properly belonging to the engineer, it behooves us to in-

quire why this is so, and seek the proper remedy to avoid it, and not be repining at our failure to be appreciated.

Most of the ideas underlying our system of technical education in the schools have been borrowed from the continental nations of Europe. On the continent we find engineers very differently situated from what they are in English-speaking countries. The continental engineers are nearly all officers of government, and their training is directed by an autocratic system which ignores the right of the individual. With us, the right of the individual is the foundation of our social system. The education and training for the one condition of social organization does not suit the other. I think we have already gone too far in copying the continental methods. The English-speaking people are above all things else utilitarians, and engineering is the most utilitarian of all professions. The system of education and training of engineers by actual work in Great Britain produced the men capable of directing the forces of nature. The training of the early engineers in the United States was patterned much after that of our English cousins; and such men as Jonathan Knight, Loammi Baldwin, Benjamin H. Latrobe, Chas. Ellet, Jr., Ashbel Welsh, 'Squire Whipple, James B. Francis, and others, show that the Americans accomplished the same things in pretty much the same way, and, in doing so, left us much to be proud of. Our employers know this, and it is one reason why they give the preference to men who are trained in the school of practice.

It was a very unfortunate thing for the people of the United States, and especially for the engineers, that political reasons had so much weight in fostering prejudice against England and English customs that our educators could only find virtue in the continental methods of training. The reflex action has been felt in England. Very naturally they would attribute much of the success of the Americans to their system of technical education, and from what I read in the English technical papers, over-education has brought certain classes of educated work in England almost to the point of starvation. They seem to have failed to realize that all education on the continent is conducted simply with a view to standing government examinations. We have been too long on this tack, and I think it is time to reduce the requirements for entrance examinations, and curtail the curriculum to such an extent that the essentials may be mastered by students.

The greatest thinker and most profound writer on engineering science in the English language, if not in the world, is acknowledged to be Rankine, and the following extract from his "Notes as to Instruction in Engineering Science, drawn up for the Information of Students," could well be made the foundation of the course of engineering instruction in the United States: "In drawing up that course, the university has had in view to avoid altogether any competition with the offices of civil engineers, or the workshops of mechanical engineers, or any interference with the usual pupilage or apprenticeship; and they have accordingly adopted a system which is capable of working in harmony with that of pupilage or apprenticeship by supplying the student with that scientific knowledge which he cannot well acquire in an office or workshop, and avoiding any pretension to give him that skill in the conduct of actual business which is to be gained by practice alone." Were all our engineering instructors thoroughly imbued with the truth of the above statement of Rankine, we would not hear of courses in Municipal Engineering, Sanitary Engineering, Structural Engineering, and all the other attempts of the schools to supply the place of actual practice, which alone can make the engineer.

If we really and truly desire to raise our standing as a body, it must be by becoming better business men and more expert in handling labor and in conducting operations than the practical man; and then, and not until then, will the engineer be always found directing the sources of power in nature. The very first thing to make this possible is to get the youth equipped with his essential scientific training before he becomes a man. Unless the schools do this the practical man will continue to hire the schoolmen and the majority of engineers to work under his direction.

Too long a time spent at school tends to destroy the development of some traits an engineer must have. One of the prime essentials of an engineer or any man of affairs is the ability to decide a question; this ability must be acquired early, and can be acquired only in actual work. The workman and foreman are all the time making decisions in their daily work. The student has nothing to decide; he must learn the tasks given by his instructors. An engineer, like the business man, must be a ready man; a student's habits will never develop this faculty, but tend to its destruction. The business man, from the very nature of things, in a free country must be the financial backer and promoter of the various enterprises we are engaged in. He knows that his success in life has depended on his force of character, practical judgment and ability to decide, and he chooses his principal agents from among the men who possess these characteristics, and the practical men who from boyhood up have been making their own way are found to possess the qualities he knows to be necessary for the conduct of affairs; so he selects the practical man, not from choice, but of necessity; and the practical man hires the educated engineer as one of his aids, and employs him in a subordinate capacity, regarding his pay in the light of a very unpleasant item ir the expense account.

I have often tried to determine the relative values of the professional equipment of an engineer, and my experience suggests:

Scientific knowledge learned at school	25 per cent.
Technical knowledge learned by practice and private study	35 per cent.
Business habits and methods learned by actual work...	40 per cent.

The proportion in which we employ this professional equipment in ordinary engineering work will show that 60 per cent. of our time is devoted to duties requiring business habits and training and 40 per cent. to duties requiring a combination of scientific and technical knowledge; the proportion of scientific knowledge to technical knowledge in this 40 per cent. varies with the work, but ordinarily it would be one-fourth scientific and three-fourths technical. These estimates, based on my own experience, which has been quite varied, show that an engineer must be a many-sided man who cannot afford to cultivate one side at the expense of the other sides. The specialist does this—the general practitioner in medicine and in law indicates to his patient or his client when to call in the specialist—so likewise should the specialist be employed in engineering.

The continual claims for engineering as a learned profession may interest those who discuss it; but, to put it mildly, it is bad policy, seeing that it tends to make those who employ us think that we feel ourselves to be wiser than they are. It would be true wisdom on our part to cease ventilating these claims. When, as a profession, we become learned the public will very quickly acknowledge the fact. The only way in which we can advance our status will be through the individual efforts of the rank and file by showing ourselves possessed of sound, practical judgment, self-reliance, good business sense, and the ready use of the technical experience and scientific knowledge required for the work in hand.

One of the most important questions to the engineer, as we all know, is that of paint, and numerous experiments have been made and are constantly in progress for determining the enduring and preservative qualities of the various paints in use. The Western Society of Engineers have on exhibition at their rooms in Chicago a station sign from Harper's Ferry, Va., which seems to have beaten the record for paint endurance. Thirty years, it is said, have not dimmed the luster of the letters, while the wood around them has been worn away about a sixteenth of an inch. The address of the painter or his secret of compounding the paint is now much desired.

A New Turret Lathe.

The accompanying illustrations show a new design of turret lathe, called by the makers a manufacturing lathe, which possesses several novel features, one of which is the provision for using common forged lathe tools instead of special and box tools. The manner in which these tools are held in recesses in the side of the turret is apparent from the picture, the adjustment for hight being by means of a pair of reverse wedges which are fitted with tongue and groove and placed in the turret recesses below the tools. In addition to the recesses for the lathe tools, the turret is fitted in the ordinary way with three holes for the reception of drills, reamers, threading tools, etc., there being three recesses for lathe tools and three holes. A fourth lathe tool is carried by a tool post placed in the position in the rear occupied by the usual cutting-off tool. This tool may, however, be traversed lengthwise of the machine so that the tool may be used for turning if desired. The relation of the two tool slides is seen most clearly in the end view. The tools are operated both by lever and crank, the former being very long, as will be seen, to give full command of the tools under heavy cuts. The levers are attached to their shafts by pinch grips to enable them to be adjusted to the most advantageous position for the work, whatever its length may be, and to permit their ready removal in case they are not needed. Stops to all movements are provided, those for the two lengthwise motions being seen in the side view, which shows them to be of substantial size and located where they belong—substantially in the line of thrust. The crosswise stops are out of sight, but are so arranged that they may be thrown out of engagement if desired to pass a tool beyond the stopping point. Means are also provided to lock the cross slide against the stops if desired, and further means are provided to locate the turret in line with the spindle for drilling and reaming. The gage for the length of the work will be seen mounted in a clamp above the front spindle bearing.

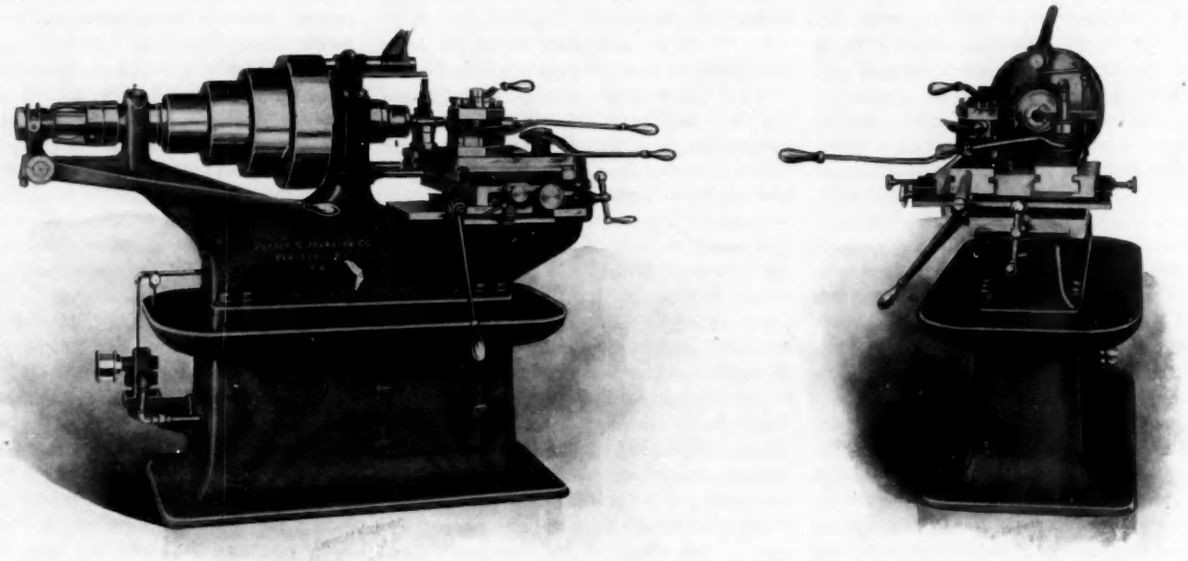
The chuck shown is of the collet type, operated by the lever alongside the machine. The noze of the spindle is fitted with a hardened and ground tool steel bushing to receive the collets—the making of the collet being all that is necessary to fit the machine for any size of stock within its range. A corresponding stump is also supplied on which expanding collets operated by the same lever are placed to grip a piece by a hole already bored. For large work a lever chuck, not shown, but operated by the same hand lever is supplied, so that any class of work may be handled, finished pieces being removed and new ones inserted without stopping the machine.

The machine has no back gear, but instead is fitted with cones of unusual capacity—16 inches diameter at the large end and of a width for a 4½-inch belt. The counter shaft is arranged for two speeds. An oil tank with pump and piping goes with the machine.

Our readers will remember Mr. Miller's observation in English shops that great reluctance is there shown to invest much money in special tools and fixtures. While not designed especially for that market, it is a matter of interest that the feature by which such tools are largely avoided has led to instant recognition of the tool in England, where it has found a ready sale.

We cannot pass this machine without noting its beautiful outlines and proportions. We are glad to see the increased attention devoted to these matters and the advance in true art which recent machines have shown. The designer of this machine is evidently an artist as well as a mechanic.

The machine is the product of the Potter & Johnston Company, Pawtucket, R. I.



A MANUFACTURING TURRET LATHE.

Arms of Uniform Caliber.

It is reported that the War Department has given orders to Col. Alfred Mordecai and Major Stanhope E. Blunt, of the Ordnance Department, and Capt. George S. Anderson, Sixth United States Cavalry, detailing them as members of a board of officers to meet at the Army Building in New York city, on Tuesday, December 6, or as soon thereafter as practicable, jointly with an officer of the navy and an officer of the Marine Corps, who may be detailed as members of the board by the Secretary of the Navy, to consider the question of adoption of a uniform caliber for small arms and machine guns and of a standard and uniform small-arm cartridge for the use of the army, navy and Marine Corps, and make report and recommendation thereon.

Down On It.

"I would like to interest you in our compressed air motor."

"Compressed nothing! I wouldn't touch it with a 10-foot pole. I'm an expansionist."—Chicago Tribune.

The annual consumption of coal per head is: In France, 0.98 ton; in Belgium, 2.65 tons, and in Great Britain and Ireland, 3.82 tons.

Letters from Practical Men.

The Human Element in Production.

Editor American Machinist:

I emphatically don't sympathize with, and don't agree with the "Superintendent," who whines about the lazy machinists in your issue of December 29. His way of putting things does not tally with the facts that are familiar to all of us. Lathes and planers and drillers and millers, and all the other tools of the shop, have been and are continually being strengthened and improved, and are having their running speeds and their feeds increased, to enable them to do more work and better work. And then do they go out into the shops to jog along at a gait that will give them nothing to brag of over the tools that they displace? That is not what they are built for. They are sold upon their promises to do big things, and they do them. They show an improved and an increased output, not by the mere improvements in their construction and in their detailed arrangements, but by the appreciation and the employment of the enhanced facilities which they embody. How can these modern tools have wide and ready sale except for the results which the men accomplish with them? It is the men and not the tools that, after all, do the work. I am talking now about a machine shop, and not about a factory. The improved tools would not make a better showing than the old ones except as they were crowded to their work by the men. If progress is shown in the tools and their product, the men's ideas of what constitutes satisfactory output must have advanced commensurately, and their practice must have kept up with the rest of it.

"Superintendent" says, only half truly, that "output depends on the man as well as on the tool." It depends much more upon the man than upon the tool. We might fairly expect that a man who takes a proper pride and interest in his work—and these traits have not perished from the shop—will, even with tools more than a quarter of a century old, do more and better work than one of "Superintendent's" men with the best tools that the market can supply.

"Superintendent" has got sick and tired of buying the best of modern tools, because they don't do for him the best of modern work at modern speed. How far has he gone in buying the best of modern skill and enterprise to go with them? Surely skill and enterprise and industry are procurable, for lots of shops have these things. His evident error is, that he has in his shop equipment accorded greater importance to his tools than to his men, and no one should be surprised at the want of success and the discouragement of one who so lacks all sense of proportion.

"Superintendent" only carries a little farther than some others a very common fault. The human element is the most important element in all production, yet it is rare indeed that it is given anything like the most of the thought and the attention. Some proprietors do much better than others. A common mistake is that the first purchase of either tools or labor covers all. With the machine tools of the shop it has at last been discovered that various attachments and auxiliary appliances are necessary to enable them to do their best. And then there is the lubrication. We in these latter days have learned how needful it is for the machinery, and we provide the best of oil, and plenty of it, and roller bearings and all anti-friction and balancing devices to make things run easy, and we find that it pays.

But when we hire a man, that generally ends it. Whoever heard of any thought given to or any money spent for labor lubrication? We hear many things that should suggest the advisability of it. There must be friction in "Superintendent's" shop, the friction of dissatisfaction and discouragement and lack of appreciation or hope of advancement. There is more friction traceable to these things among the men, and more lost all around by the prevalence of such conditions than by dry bearings in the machinery. Managers and superintendents and foremen are seldom neutral, but are constantly either contributing to the friction or promoting the lubrication. They should make a study of these things; but the highest success comes, after all, only by instinct.

TECUMSEH SWIFT.

Modern Boiler Practice.

Editor American Machinist:

The remarks in the "American Machinist" of November 24 relative to the differences between English and American boiler making are noteworthy, and, while I would not, myself, advise or recommend the punching of rivet holes, I must say that the use of the punch need not of necessity be so damaging as it is sometimes found to be. Clean, sharp edges to punch and die should be maintained, and it seems strange that punching cannot be done twice over so as to remove the strained bit of metal around the first punched hole. The second punching would also enable us to get the hole less taper. A drilled hole is all right; but the corners should be carefully rounded off, and this is often neglected.

But what always struck me as the great weakness of American boiler practice was the enormous pressure allowed to be carried. I have not seen the latest rules of the Board of Supervising Inspectors, but ten years ago they allowed pressures on single riveted shells that were only allowed in England on double-riveted shells, while on the Mississippi even higher allowances were made. The reason for this last I never learned, especially as Mississippi captains have always had the credit of sitting on the safety valve lever in times of hurry. In the early days of steel boilers there were difficulties with punching, as steel was less reliable than it now is, or less understood, and this fact helped on the system of drilling.

As regards the use of copper fireboxes in locomotives, much of the continued use of copper is due to the universal use of the fire-brick arch in the firebox. If a boiler is washed out hot—of course it never should be—the brick arch and the steel plate do not work well together. Has anyone any experience of steel fireboxes with brick arches and hot washing out which would throw any light on this question? One railway here does use steel for its fireboxes, but I do not know what their washing out practice may be. The question of time to cool down seems to be involved. Of late years the boiler business has undergone great development. Up to the time of corrugated furnaces there was not much increase in pressures, because it was said that the furnace was the weakest part of a boiler; although the Adamson flanged seam really enabled furnaces to be made as strong as they were then required. With the advent of corrugated and ribbed furnaces, however, there was at once a cheaper means of making furnaces much stronger, and steam pressures began to go up rapidly, and, so far as stationary work is concerned, shell diameters have also gone up, so that, where an internally-fired Lancashire type of boiler in 1883 measured 7 feet by 28 feet, and was 7-16 inch thick, to carry 75 pounds pressure, we now find boilers 8½ feet by 32 feet, built of steel and butt riveted, with double straps. Formerly there were three plates in a circumference of a 7-foot boiler; now one plate alone goes to a circumference in much larger boilers, and pressures which were looked on as high (100 pounds) in 1883, are now high at 200 or 250 pounds.

The beginning of the improvement in boiler making was due to Daniel Adamson in great measure. He first used steel, having the courage of his convictions, and invented the flanged seam. Before his time the steam boiler was a very rough affair, of sheared plates, roughly punched holes, and with the gusset stays only held to a single angle iron by bent—not closed—rivets. The various mountings were attached to blocks of cast iron riveted on, but it had not been long before that time that mountings were simply bolted directly on the shell crown. Now all mounting blocks are of steel and all stays are properly closed between two angle bars. In spite of all this there is very little advance in the use of boilers. They are still fed with scale-producing water, and the question of mechanical stoking is still unsettled.

It has been recently proposed to heat feed water by waste gases on a new system. The economizer, or flue feed heater,

is employed for the purpose, and is fed with distilled water kept in continuous circulation. No scale can thus be formed in the economizer. In the course of the circulatory system this distilled water is led through the feed heater proper, and gives up its heat to the water therein. Such a system should be applicable to the separating of scale-forming matter in a soft state, if such is possible. In this matter of scale, however, it is a mistake to suppose that scale only hardens in the presence of fire heat, for it is well known to form in and on the feed inlet pipe, which is surrounded by water and nowhere near the fire. As lime salts separate from water they are in a condition to crystallize into a solid mass, and they do so crystallize. Hence the use of some mucilaginous substance to cover each minute molecule with a protecting surface and prevent their adherence into larger masses. It is this power of crystallization which prevents the spread of some of the appliances for scale catching which are inserted in boilers to trap the lime salts before they get into the boiler itself.

W. H. Booth.

London, England.

Spherical Turning on the Lathe Centers.

Editor American Machinist:

The following method of turning balls and fillets, while not new, is not generally practiced, and may prove interesting to some of the younger lathe hands, if not to the older ones.

To begin with, a lathe with a compound rest is necessary. Remove the top slide and there will be found in the lower one a pin or a hole upon which the top piece swivels. Find the center of this pin or hole, and get this center directly under the line of centers of the lathe. This can be done by the use of a square, getting the edge of the square beam even with the center of the pin or hole, and the upper edge even with the point of the live center. Lock the cross slide then in this position by tightening the gib screws; replace the top slide and you are ready to begin to turn balls.

Fig. 1 represents one end of a ball-end connecting rod for a marine engine throttle and reverse gear, and a description of how to turn it will give an idea of the whole principle. There are usually six of these rods on a marine engine, and their length varies from 3 to 8 feet. They first come to the lathe in a rough forging like Fig. 2, consisting of a ball and about 1 foot of rod, and, after having the ball, and, say, 3 inches of the rod turned and finished, they are returned to the smith shop to have the required length of rod welded between two of the stubs. They are then returned to the lathe and are turned from ball to ball.

Center both ends of the stub and take a straight cut over the ball, as at *A*, Fig. 2, leaving just enough stock for a water finishing cut. Then take a piece of tin or sheet brass and lay out the ball and fillet full size, as in Fig. 1, which will show how far to turn the ball so as not to get below fillet. Run the top slide back so that the tool-post will be back of the work, and run the lathe backwards. Use a narrow round nose-tool, like Fig. 3. The top slide must be free to swivel in any direction, and by setting as in Fig. 4 you can turn a perfect sphere.

Before turning out quite all the flat put a center punch mark on it at *A*, Fig. 1, or a light line *B*, Fig. 2, and setting the dividers to the distance from *A* to *B*, Fig. 1, you mark off the point to which the ball turning tool may go. It is obvious that the last part of the flat turned out is the center, and this locates *A* correctly. You can determine beforehand where you want the center to be, and by making the tool touch an equal distance either side of that point you can turn two balls on one rod an exact distance apart, or turn a ball in the center of a rod, or in any position required.

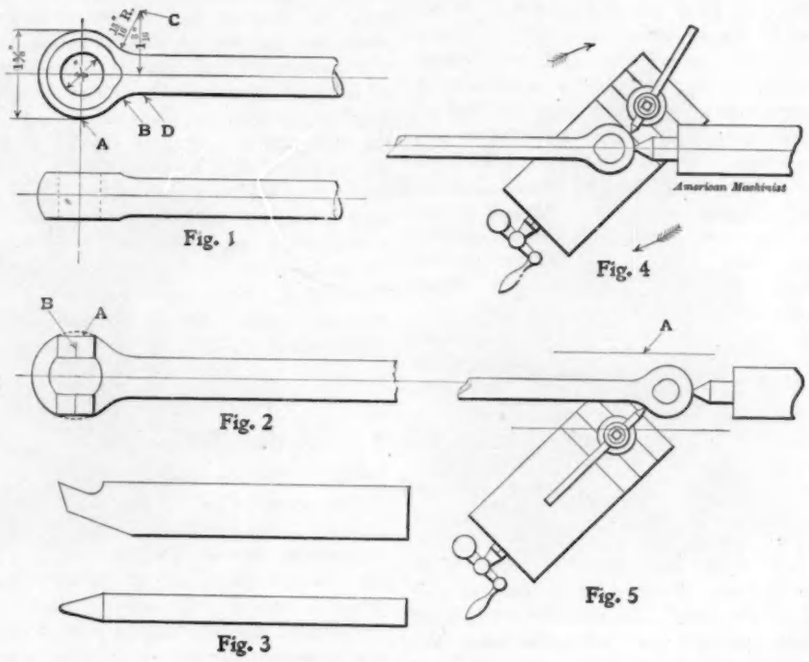


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

SPHERICAL TURNING.

After finishing the ball with a water cut, scribe a line at the back of the lower slide, so that it can be set central at any future time without removing the top slide. Then run the lower slide toward the front of the lathe, so that the center of the swivel pin will be in position of center *C*, Fig. 1. This can be done by holding a scale against the back of the lower slide, and when the 1 3-16-inch line coincides with the line previously drawn, there you are. You can now work out the fillet by swiveling the rest as for the ball, except that the lathe runs forward, as in Fig. 5. The fillet will be complete as soon as it touches the ball, and if care is taken, there will be no lump where they meet.

I turn the straight part before the fillet, and by just touching the finished rod and advancing toward the ball for each successive sweep, the whole job is finished when I touch the ball. The rod may be turned the required size and distance before turning fillet by setting the dividers and marking from *A* to *D*, Fig. 1.

Many other applications of the above practice will readily suggest themselves. The size of ball which may be turned is limited only by the distance the tool-post can be run past the swivel pin.

C. Z. D.

[The above will be of interest to our readers as showing how one man does a certain job. It may also suggest to some how they would have done it somewhat differently. We are entirely unable to understand why the tool should have been used behind the centers, with the lathe running backward, for turning the ball. Something might have been said also about a preliminary facing of the end, with perhaps a suggestion that the center of the ball should have been located from that.—Ed.]

Rapid Tapping.

Editor American Machinist:

Undoubtedly most of the readers of the "American Machinist" are, through its columns, kept pretty well informed on everything pertaining to new or quick ways of working. If in the following there is nothing new about tapping, there still must be something quick in the work, or else I must be slow.

My friend, who is the general foreman in a small shop of about twenty hands,

building lathes, and whose modesty forbids my using his name, informed me that on a lathe which they build there are only about six or eight holes that are tapped by hand, all the rest, about sixty or seventy, being done on a modern driller built in this city. Mr. Foreman, as I shall have to call my friend, said that even the holes in a steady rest and in pulleys were tapped on the press. To tap any hole in fifteen seconds appears to me to be rapid work; but it is no unusual thing at Mr. Foreman's shop to run a ½ or ⅝-inch tap through ¾ inch of cast iron and out again in that time. I might also add that the taps are generally run on the same speed as the drill, only going a little slower than the drilling speed when the taps get over ¾ inch, or where more power is needed; then the machine is thrown into gear. When I asked Mr. Foreman if he did not have taps twist once in a while, he assured me that that seldom happened. He also informed me that he always endeavored to get all the drilling done first. They then start the tapping, taking all the holes of one size first, and keeping the machine at tapping until it is all done, and in that way avoid as much as possible changing the machine.

When there are taken in consideration the, say sixty, holes that are to be tapped, which would average, say, one minute each when tapped on the driller, while if tapped by hand the same would take not less than seven minutes apiece, it shows a saving of six minutes on every hole tapped, or sixty times six minutes, six hours, on every lathe built. It may be learned from the above statement about how long it takes to do all the tapping on one lathe, allowing, of course, a little time for changes of the rigging, etc.

In striking contrast with this small shop that I have referred to, there is another larger shop in this city employing not less than 400 more hands than the small shop, where they still do most of their tapping by hand and are very much out of date. The small shop, it can be seen, is not always the slowest or the out of date shop.

H. L. CAMERON.

Cincinnati, O.

Boiler Feeding —Taboo the "Wrist-Pin."

Editor American Machinist.

There is not a chemist's trace of a chance that Tecumseh Swift stands in need of any advice or information about whether a boiler can be fed for nothing or not. I confess that I do not know just what he is trying to get at in his letter of October 20. It is worth while, however, to inquire into the magnitude of the saving in case a boiler could be fed gratis, for sometimes saving is not profitable. An instance of this kind was called attention to at a nail manufacturers' meeting not long ago, where it was shown that it did not pay a carpenter to pick up a nail that he had dropped, i. e., his time could be more profitably employed than in picking up individual nails. Such calculations are easily made, as it is only necessary to know the cost of the nail, the time required to pick it up, and the rate of wages the carpenter receives, to determine the question. It is quite as simple to compute the cost of feeding a boiler. Take the following example as an illustration. Suppose that we carry a steam pressure that would require the water to be forced to an elevation of 200 feet in order that it would flow into the boiler by gravity, and that it will take 30 pounds of water per horse-power per hour. Then we have $30 \times 200 = 6{,}000$ foot-pounds per horse-power per hour, or $\frac{6{,}000}{60 \times 33{,}000} = .003$ horse-power, or say, .3 of 1 per cent. We have been so accustomed to hearing of saving from 15 to 50 per cent. by the introduction of various economizers, that one would stand but a poor chance of making sales, or even getting an audience with the manufacturers these busy times, if he could only guarantee so small a saving as .3 per cent. in the coal used. In carrying the analogy between the carpenter and feed pump a little further we shall see that the former will only have to drop three nails out of every thousand that he drives to represent a loss that is proportionately equal to the cost of feeding a boiler. Hence, a magnetic non-nail-dropping device for carpenters might be as profitable as a boiler feeder run by a wind-mill.

A better comparison of the cost of boiler feeding may be made by noting the saving to be effected by heating the feed water, either from exhaust steam or from the gases escaping up the chimney, as a calculation will show that a greater gain will be effected by increasing the temperature of the feed five degrees, than if the water was fed into the boiler at its former temperature for nothing.

Mr. Swift's "Precise Meaning of Words" in your issue of December 23 is one of his best letters. His definitions of the words in question are clear, and the illustrations he gives of their proper use makes them easy to remember. I regret that he did not take up the names of some of the details of engines or machine tools that are confusing and ought to be obsolete. "Wrist pin," for instance, is often used to mean crank pin, cur's head pin, rocker pin, eccentric rod pin, etc. Let the good work go on.

J. H. DUNBAR.

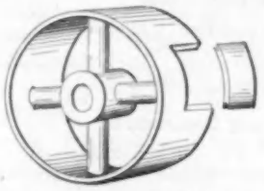
Youngstown, O.

A Couple of Repair Jobs.

Editor American Machinist:

I send you herewith two sketches of repairs which I have found to be of especial service. The first shows how a broken pulley can be repaired; and if a close fit is made, the patch can hardly be noticed. I usually, after having the parts fit perfectly, rub the contacts well with a piece of brass wire, so as to look brassy, and then sweat solder all through the seam. Very often cast-iron pulleys get a chunk knocked out of them, and this is the quickest and best way I ever saw for getting out of an ugly scrape of this kind.

Fig. 2 shows a round iron clamp, hastily prepared to close up a crack in an elevator cylinder. There are clamps and clamps; but this one is a clamper "from 'way back," fits close, makes a neat-looking job and cheap construction; has straight pull and nothing to bend or break. These are homely kinks, but they do the business.



Patching a Broken Pulley

Fig. 1

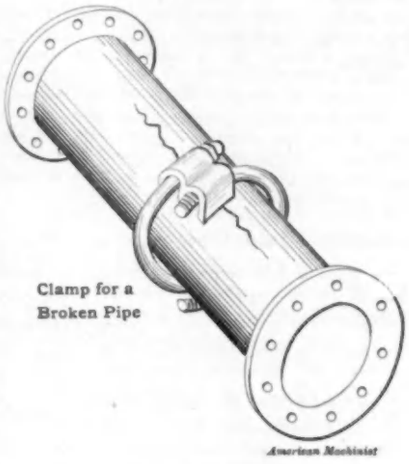


Fig. 2

A COUPLE OF REPAIR JOBS.

L. C. SHARP.

Omaha, Neb.

Charges by Foreign Express Companies.

Editor American Machinist:

Apropos of your article in reference to regulating express companies' charges, don't forget the foreign express companies or the so-called commission and custom house brokers.

Compared to them the domestic express companies are mild. One is simply high-priced, but the other is highway robbery.

At least the domestic express companies have a rate according to weight and distance, but the custom house broker and foreign express company (combined) are only limited by how much you will stand. You can't get a price beforehand, and their ingenuity in inventing charges is great.

DURBROW & HEARNE MFG. CO.

New York.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Press,

218 William st., New York.

JOHN A. HILL, President and Treasurer.
A. LEIGHTON DONNELL, Sec'y.

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Subscription Price:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, everywhere.

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Nepotism in Machine Shops.

One of the main objects of most men's work is to provide for their children. It is natural and right that a man should concern himself regarding the welfare of his sons, and if the man is proprietor of a machine shop and can see nothing for his son to do better than to become a worker in and a participant in his business, it is in accordance with human nature that such participation should take place, and though this is often criticized, who is there among the critics that can say that he himself would not pursue the same course under the same circumstances? There are many reasons for it aside from natural affection and concern for the welfare of progeny. A man feels that he can trust his own son with the innermost secrets of his business without reserve, and he can usually feel sure that the son's knowledge of the business will never be used in the service of a competing establishment. There are numerous cases in which the plan has worked and is working well in spite of its inherent drawbacks. For we must concede that it has its peculiar drawbacks, and when these do not work serious injury to the establishment it is because there is a father having unusually good judgment and sons having an unusual amount of good common sense. We have known cases where a shop proprietor has objected to the son of his foreman being taken on as an apprentice because he feared favoritism, jealousy and demoralization, while at the same time this proprietor's own son was in the works skipping about from machine shop to pattern room and drafting room "to learn the practical side of the business," all within a year or so. This may be justified by saying simply that the shop belongs to its owner and that he ought to have the right to run it in his own way and to do as he pleases with it. While this would be true enough, it is certainly the part of wisdom to recognize the facts of the matter and be able so far as possible to count the cost in advance.

In the first place we may consider the effect upon the son, for this effect, be it good or bad, is usually the main incentive to the practice referred to. The first thing that becomes apparent is that the son can rarely if ever get his own measure, so to speak. This can be obtained only by individual effort made upon a common ground with one's associates, and we know that in some cases, at least, men who have been brought into the business because of sonship and have succeeded have always felt regret that, though they themselves or others might conclude that their success had been or could have been fairly earned, there were no means of absolutely proving it; or, that they would have been more successful than their early associates if their environment and opportunities had been the same. Self-reliance, initiative and the sound judgment which comes to most of us only by acting with full responsibility for success or failure certainly have much less opportunity for development, and unless the son is unusually endowed with good sense there is apt to grow up within his mind a false idea of his own importance and superiority which is fatal to the highest success in dealing with other men, whether employees or customers.

As to the effects upon the business of the establishment, our observation leads us to think that the discouragement and final leaving of bright men who would otherwise remain and be a source of strength is the most serious. It is a hard fact that men who are capable of and who do render valuable service to a manufacturing establishment are capable of knowing that fact and do know it. They also know that positions of responsibility, leading perhaps to sole or joint ownership, are as accessible to them as to other well-equipped men in establishments where all have an equal chance and when such a man finds himself in a place where all such avenues of advancement are filled by relatives of the proprietor, whom our man believes will retain their places and be advanced regardless of actual merit, he immediately looks for another place and eventually leaves. The point here is that it usually is the very best men who are thus prevented from doing what they would do if they remained, i. e., using their talents in strengthening and building up the business.

In a large establishment with only one family to provide for this trouble is not usually seriously felt, for there is spare room at or near the top, but in a small establishment it often is to our certain knowledge a serious handicap, and in large corporations with numerous directors looking for places it has worked mischief and opened the way—indeed been the direct cause of the establishment of able, successful and harassing competition. Brains are at best none too plentiful in manufacturing establishments, and those who possess them must be induced to remain in service, or the establishment inevitably suffers.

Each case must to a certain extent be a law unto itself and must be decided by itself. Except in the case of partnerships or corporations where other part owners are concerned, there is, so far as we can see, no question of moral right or wrong in it, except in those cases where, as sometimes happens, a man who has for years rendered faithful and valuable service with an express or implied understanding that opportunities for advancement should be his, eventually finds a young relative of somebody or other jumped over his head. The whole matter is really a complicated one; wise fathers and sensible sons solve it satisfactorily; others do not, and much trouble ensues for all concerned. It does not, however, rest upon the same basis as does nepotism in public service, and is not to be judged by the same standard.

What Can a Little Shop Do?

"A young mechanic, with a knowledge of tools and of machine-shop practice, has his own small shop, with planer, lathe, drill, etc., and wants to start a small business of his own and build up a trade. What articles (which could be made with these tools) are in fair demand and would be good to start on? I had thought of, among other things, screw-cutting dies in sets; what do you think of this? Any suggestion will be thankfully received."

The above *bona-fide* letter, which has recently come to us, is by no means an isolated or exceptional one. It should be an easy one to answer, in a way, but to give such an answer as would be welcome and satisfactory to the questioner is, perhaps, an impossibility. Indeed, it is not improbable that the writer has investigated to some extent for himself, and has found only discouragement, and that he now writes us in the hope of some more encouraging suggestion. If he has not so investigated, he should do so, and he would not have far to go. He lives, by the way, in Chicago. In the matter of the screw-cutting dies that he speaks of making, let him see what a variety of dies

there are in the market, how beautifully and accurately they are made, and how cheaply they are sold, notwithstanding the cost of their distribution, and the commissions to those who handle them. The most modern methods of manufacture are employed in their production, and all the known devices for accuracy and speed. The material is bought in large quantities, and the work also is done by wholesale, and large stocks of the finished goods must also be carried. It is evidently absolutely hopeless for a little shop, with two or three men at the most, and with only the common tools of the everyday machine shop, to attempt to compete with the established manufacture of the standard small tools or similar articles. If our friend upon sufficient investigation does not realize all this, he must be peculiarly constituted.

What, then, is a fellow to do who is situated like our correspondent? How is he to find remunerative employment? That is for him to find out. This is not a flippant answer to the question that is troubling him, but is the best answer that the case admits of, and is, indeed, an accurate statement of the only possible solution. It is in this way that the thing is being solved continually. The law of the struggle for existence and of the survival of the fittest is nowhere more fully operative. Not all, and, indeed, only a few of the small shops survive and thrive; but some of them grow vigorously and become the great concerns of national or world-wide repute. They do it and they have done it by striking out new lines of manufacture, and only very rarely by trying to cut into already established and successful trade. But everything is full, and all known opportunities for activity are fully occupied and no opening invites in any direction. This is only saying over again that everything has been invented and all the improvements have been made, when every day is bringing its contradiction. The establishment of a little shop and its growth into a big one is a familiar incident in our industrial history, and it is not even in these days a rare one; but of scarcely one of those shops could any prophet have predicted the lines of its development. With such shops which we have known there has been usually a young, brainy, but not too brainy, and pushing mechanic who has first of all gone into general work, doing whatever he could find to do, jobbing, repairing, experimenting, model making, and while busy at this he has struck some novelty or improvement or specialty in which he has seen his looked-for opportunity, and has appropriated it instinctively. The only hope we can suggest for our inquiring young friend, with whom we heartily sympathize, lies in the direction we have indicated, and we wish him and others like him all possible success. It may or it may not afford him some encouragement to assure him that if he does not succeed many others will.

Rejuvenated "Locomotive Engineering."

Our readers were duly informed of the serious fire which destroyed the upper works of the sky scraper at 256 Broadway, which we were so fortunate as to have vacated only a few days before, and of the total destruction of almost every sublunary thing pertaining to our one-time fledgeling and later neighbor and co-worker, "Locomotive Engineering." Our sympathies and condolences with our neighbor in its apparently overwhelming misfortune we are already disposed to consider wasted. The January issue was on hand promptly on time, in quantity, quality and variety unsurpassed, and typographically more attractive than ever. We have taken great pleasure in looking through the number. We especially delight in reading pictures, and we are not ashamed to confess that we learned much from a series of nine views showing the different stages in the erection of a Vauclain four-cylinder compound locomotive at the Baldwin Locomotive Works. We had always thought of the cylinders of a locomotive as attachments to the boiler, but it seems that we have been entirely wrong in the matter. If you are going to erect a locomotive you want the cylinders first of all. They must be set carefully in place, and the frame and the boiler and the other little things are just bolted on to them. The whole story is told in the pictures referred to, and all who are interested in the locomotive should see them.

Inquiry for Machinery.

Those who make or may know of the makers of such machinery as is called for below, will oblige us by sending name and address, mentioning the number of the inquiry. We cannot forward catalogs. We have inquiry as follows:

89—Makers of power crank presses for molding small porcelain pieces.

Must Press the Right Button.

A writer in one of our English exchanges says American wood working machinery is too clever. He doesn't like, when trying to get a 3-inch plank, to find that the machine has turned out a beautiful arm chair because he had pressed the wrong button.

The annual address of J. S. Walker, president of the Engineering Association of the South, printed elsewhere in this issue, will be found to well repay the reading. It is original and upon somewhat unusual lines, and in many particulars is a statement of another side which should not be lost sight of when considering the status of the engineer and the most effective means for his advancement.

Personal.

Mr. C. S. Corkery, formerly of the Waltham Emery Wheel Company, has associated himself with the American Emery Wheel Works, Providence, R. I., and will travel in New England for the latter concern.

Mr. J. L. Osgood, who commenced life as a machinist and toolmaker and for some time past has been manager of the machinery business of R. Hoffeld & Co., of Buffalo, has become the Buffalo representative of the Pratt & Whitney Company, and will open a store there in which a stock of small tools and machinery will be carried.

Mr. M. J. Martinez has received the appointment of resident agent at Havana, Cuba, for The Aultman & Taylor Machinery Company, Mansfield, Ohio, manufacturers of the "Cahall" vertical and the "Cahall" horizontal water tube boilers. Business will be conducted under the style of Mr. M. J. Martinez, consulting and contracting engineer.

Obituary.

John H. Egan, superintendent of the pattern department of E. P. Allis & Co., Milwaukee, Wis., died in that city, December 25, forty-seven years old.

W. Dewees Wood, president of the W. Dewees Wood Company, McKeesport, Pa., sheet iron manufacturers, died at Pittsburgh, January 2, seventy-three years old.

S. S. Bent died at Port Chester, N. Y., December 31, seventy years old. He at one time owned an iron foundry on the East River in this city, and later operated the Globe Iron Works at Port Chester.

Thomas Coombe, proprietor of a foundry and machine shop at Lambertville, N. J., died at Plymouth, England, December 31. Mr. Coombe was a native of England and was on his twentieth visit to his old home.

News was lately received by the Baldwin Locomotive Works of the death, in Colombia, S. A., of George P. Hodgman, one of their most valued engineers. Mr. Hodgman had gone to Colombia in charge of some new locomotives and died of fever.

William H. Schultz, an engineer and inventor, at one time in charge of the shops of the Philadelphia, Germantown & Norristown Railroad, where he built locomotives and contributed many improvements, died at Wilmington, Del., January 3; ninety-four years old.

Joshua Juloes Harrison, proprietor of a machine shop at Connersville, Ind., died recently at that place, of consumption; fifty-three years old. He was for many years connected with the Root Blower Works, and established his independent business in 1875.

Harry Robinson, a colored engineer who had been in the employ of the Staten Isl-

and Ferry Company more than forty years, died in this city January 4, about eighty years old. He was engineer of the ferry-boat Westfield when her boiler exploded twenty years ago, killing nearly 100 people, but he was exonerated from all blame for the accident.

Samuel C. Johnson, president of the Yale Safe & Iron Company, of West Haven, Conn., died at New Haven, January 2; sixty-three years old.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(3) J. C. C., asks of what does the Harveyizing process consist. A.—It consists of nothing very much or essentially different from the old familiar case hardening process. The plates to be hardened are simply packed with bone charcoal next to the side it is desired to harden, heated and kept hot for the absorption of carbon by the plate, which is then removed, placed upon suitable supports and numerous small jets of water projected against the surface to be hardened.

(4) E. M. B., Springfield, Ohio, asks, Can taps or other tools of that kind be made of Mushet steel, and if so, how is it done, and can Mushet steel be softened, and if so, how? A.—Mushet steel can be made somewhat softer than it ordinarily is by heating and so covering it that it must cool very slowly. It is still rather difficult to work when in this condition, however, as it cannot be softened as carbon steel can be, and while taps, reamers, etc., can be made from it, it is, generally speaking, not a practicable operation, and in nearly, if not quite every case, it is much the better to use the best carbon steel for such articles.

(5) W. C. L. asks which is the proper way to place a check valve on the feed pipe to a boiler. Should the check be between the boiler and globe valve or should the globe valve be next to the boiler? I am satisfied the globe valve should be next to the boiler, and Oliver Evans tells me this also, but I have two engineers who hold a different opinion. A.—We think that the globe valve or its equivalent should be always placed next to the boiler and between the boiler and the check valve. The reason for this is that in case anything goes wrong with the check valve, such as leaking caused by a foreign substance getting into it, or if for any reason it fails to seat properly, the globe valve can be closed and the check valve examined and repaired if necessary without letting steam or water out of the boiler. When a globe valve is used for this it is best to have one with a solid disk, that is, not loose on the stem, and a plug cock or gate valve is better we think than a globe valve for this purpose. Using the ordinary globe valve it has been found that when, as sometimes happens, the disk becomes loose, it will drop on the seat and act as a check valve, preventing any water from entering the boiler, that is if the valve is put on with the pressure from the boiler against the underside, as it should be, because when put on the other way the stem cannot be packed with pressure on the boiler.

(6) P. C. J., San Francisco, Cal., sends the accompanying sketch and asks: Does the shrinkage contract iron (or other material) tangential to the arc *A B*, or at right angles to center line *C D*? Is it proper in laying out work for the pattern maker to allow, in this case, shrinkage

on 15-foot radius, or to lay out the 16 feet actual size and allow shrinkage each side of line *A B*? In one case the inside radius would be about 15 feet 2 inches, and in the other it would be 14 feet 11⅞ inches. Which, if either, is correct? Does the curvature of the segment accommodate itself to the proper radius after molding when shrinkage is taken into account on said radius? A.—The matter is not as complicated or difficult as our correspondent seems to imagine. If he was dealing with a complete ring instead of a segment he would know of course that it would shrink in diameter at the regular rate of shrinkage. It is not different in any respect with the segment. It will shrink equally in all directions, precisely the same as if it were an integral part of a complete ring. The pattern maker merely works to a slightly larger scale, and all his measures should be to that scale. The inner radius of the segment, then, allowing ⅛ inch to the foot, would be 15 feet 1⅞ inches, the radius of the middle line *A B* of the rim would be 16 feet 2 inches, and the radius of the outside of the rim would be 17 feet 2⅛ inches. The subsequent foundry experience with the pattern might perhaps seem to show that the theory in the case was not correct. The segment when cooled might prove to have perhaps more or perhaps less than the correct curvature, but this would not be the fault of the pattern. The cause would be rather in the gating of the mold, and much more in the uncovering of the hot casting and the precedence given to the different parts of it in cooling. It would probably be best to secure an equal rate of cooling for both the inner and the outer surfaces if possible.

Pittsburgh the Steel City.

At the annual banquet of the Pittsburg Chamber of Commerce, Andrew Carnegie said:

"There is not a district in this world to which the Pittsburg district cannot to-day send steel and pay the freight and deliver that steel as cheap or cheaper than it can be made at the point of delivery, if we except Colorado, to which the freight is greater than the difference in cost of manufacture at the two points. Should the South be successful in its present attempt to manufacture steel, we may have to except another point. Colorado excepted, the Pittsburg district has the whole world to-day at its feet. Pittsburg is indeed the steel city."

The New York Auto-Truck Company, which has been incorporated recently with a capital of $1,000,000, is promising soon to make an important exhibition or practical application of compressed air in a new field of usefulness. It is proposed to put in operation in the streets a number of the auto-trucks for the conveyance of heavy loads, beginning with coal. There is considerable promise of success to the enterprise, as the trucks have quietly had a very thorough trial, and practically unlimited capital is enlisted.

It seems that the War Department officials have been somewhat annoyed by the introduction into matters connected with Government contracts of some of the disreputable methods which are regularly followed by some trade papers in private business transactions; this method being to claim that if an advertising contract is signed, the publishers of such a paper or the advertising representative of it will exert his mighty influence in some way to secure an order. In other words, he offers to do something outside of the advertising contract in consideration of such contract being signed. In cases where it has been claimed that influence could be exerted in favor of an advertiser in the matter of a Government contract, this has come to the ears of the Government officials, and they have taken pains to say that no such influence can be exerted by a publisher and that an attempt to exert such influence would be prejudicial to the manufacturer, rather than otherwise.

Business Specials.

Gear wheels, gear cutting, Grant; see p. 16.

Forming Lathes. Mer. Machine Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

Watch and clock tools, small automatic machines, punches and dies, etc.; accurate work our specialty. Waltham Machine Works, Waltham, Mass.

For Sale or Rent—Foundry and machine shop with additional land, in good condition and well equipped for medium heavy work; capacity of foundry 7 tons per day; located on railroad within eight miles of New York; terms easy. Call or address J. F. Sweasy, 26 Nassau street, New York.

Complete set American Machinists, 1877 to 1898, for sale; first 18 vols. bound in morocco, uniform in style (binding alone cost $4.75 per vol.); 1896 vol. 19 in cloth; 1897 vol. 20 includes advertising, and is in leather; 19 volumes have name of private individual on side; will sell the twenty volumes complete for $100. Address Volumes, care AMERICAN MACHINIST.